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MORPHOLOGICAL STUDIES OF THE GENUS CERCOSPORA

COMMONWEALTH MYCOLOGICAL INSTITUTE

WITH FOUR PLATES

BY

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Contribution from the
Botanical Laboratories of the University of Illinois

THESIS

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INTRODUCTION

History

The genus Cercospora was established by Fresenius in 1863, the name being derived from the Greek *kerkos*—a tail, and *spora*—a spore. Fresenius did not, however, distinctly characterize the genus but merely listed four species with descriptions, confining his remarks concerning the genus to a footnote to the description of *C. apii* Fresen., the type species. In the footnote he states: "Dieser Pilz, welchen ich von Herrn Fuckel mitgetheilt erhielt,war unter den beschriebenen Gattungen nicht wohl unterzubringen. Ich belegte ihn daher wegen der mitunter lang ausgezogenen Schwanze der Sporen mit obigen Gattungsnamen, 'Cercospora' . . . . Cylindrische Sporen kommen eigentlich hier nicht vor und von den Fusisporien weichen die Cercosporen in der Beschaffenheit der sporentragenden Fäden und der Sporenformen selbst ab." These are the only generalizations made by Fresenius. He states that it is not advisable to further describe the genus until there is a better understanding of this group of fungi. The limits of the genus are, therefore, not specifically defined but are left for later interpretation.

Cooke (1875) described the genus Virgasporium, listing two species, *V. maculatum* Cooke and *V. clavatum* (Gerard) Cooke. Later, accepting Saccardo's statement that this genus was identical with Cercospora, Cooke (1875a) transferred the two species to that genus.

Since the establishment of the genus, numerous species have been added by various workers. Saccardo, in volumes one and two of Michelia, mentioned and described fifty-eight species. He illustrated many of these and others in his Fungi Italici. Ellis and Everhart (1885–1888) described many new North American species. Descriptions of numerous Alabama species were given by Atkinson (1891). The last two papers also contain rather detailed descriptions and discussions of the genus and its limits. In 1900, Carver published a list of the Cercosporae of Macon Co., Alabama, adding several new host plants for already described species. Of the other workers, Lindau (1910) deserves special mention for enumerating with descriptions, discussions, and some illustrations all the central European species known at the time of his work.

Besides these works, a large number of local lists of fungi have recorded and described Cercosporae, so that the genus is at present quite formidable. Saccardo, in the Sylloge Fungorum, lists approximately five hundred species.

Since the issue of the last volume of this work containing Cercosporae, many new species have been added, so that the total number of species is now much larger.

The early concepts of the genus Cercospora included all the Moniliaceae and Dematiaceae with well-developed conidiophores and long filiform conidia. As such, it was very close to Ramularia (of the type of *R. tulasnei* Sacc.), being separated from it principally on the basis of conidial length. When Saccardo constructed his system of classification based primarily on color, it became necessary to separate the hyaline from the colored forms. Saccardo (1880), therefore, established the genus Cercosporella to include all hyaline Cercosporae. Spegazzini (1910) further split up the genus in establishing the genus Cercosporina, which he made to include all Cercosporae with colored conidiophores and hyaline conidia.

Ellis and Everhart grouped the species for convenience into sections based on presence or absence of color in the conidiophores and on the nature of the spots produced. They did not, at that time, recognize the genus Cercosporella of Saccardo.

No other attempt has been made to divide the Cercosporae into sections. Von Höhnel (1902) has suggested that the genus may readily be divided on the basis of the manner of emergence of the conidiophores, i.e., whether they protrude through the stomata or rupture the epidermis and cuticle. Lindau, however, does not consider this a good divisional character, stating that the manner of emergence is undoubtedly due to the nature of the host rather than to any fundamental difference in the Cercospora species.

It has generally been held that the Cercospora species are fairly strict in their parasitism, each being limited to one host species or to a few very closely related host species. For this reason, use has been made of host reaction coupled with size of conidiophores and conidia as primary characters for species delimitation. In a recent taxonomic study of the genus, Welles (1924, 1925) indicates that host range is not limited to any family or group of plants and that the characters just mentioned are greatly modified by the various hosts. He concludes that "the only valuable taxonomic criteria which have presented themselves for use in separating various species of Cercospora are physiological behavior on artificial media and extent of parasitism."

Materials and Methods

The studies of the fungi of this investigation were all made from dried specimens from the University of Illinois Herbarium, from various exsiccati and a few secured from the Royal Botanic Garden at Kew, the New York Botanical Garden, and the Missouri Botanical Garden. They were prepared for study by boiling in a sodium hydroxide solution to soften

them and to remove the coloring matter of the host. They were then boiled in water to remove the sodium hydroxide.

The measurements recorded for conidia, conidiophores, and mycelium, with the exception of measurements of length, were all made with the oil immersion lens. Measurements of length were made with the 4 mm. objective. Whenever possible they were made for both dry and boiled material. Diameter of conidia was measured at both the base and tip. Conidial measurements are recorded in the descriptions as follows; length×diameter of base×diameter of tip. When any single character requiring numerical expression is described with three figures, e.g., 20–150–225, the first number indicates the minimum observed; the second, the usual maximum; and the last, an occasional maximum.

Color, when not readily assignable to a specific category, was determined by comparison with the Ridgway (1912) color standards and the nomenclature of them employed. The color of conidia and conidiophores was determined from water mounts of the dried material, while that of the mycelium was determined from material prepared as indicated above. These color determinations were always made by transmitted daylight. Artificial light was never used.

A preliminary survey of over one hundred species was made in order to acquire some general concepts as to variability of form in Cercospora and to aid in selection of species for a more detailed study. Those studied in detail are listed in the sections with full descriptions. Those not yet studied in detail are listed with citation to place of original description and the source of the specimen examined. In the latter case, species determinations were accepted as recorded.

Citations to literature following the specific names of described species include publications of descriptions and of new host plants. Illustrations are also listed. While these lists undoubtedly are not in all cases complete, an effort has been made to make them complete. It is hoped that all the important references have been secured.

Acknowledgment

The work upon which this paper is based was done in the plant pathology laboratory of the University of Illinois under the direction of Professor F. L. Stevens. The writer is greatly indebted to Professor Stevens for the suggestion of the problem and for kindly criticism and suggestions offered during the course of the investigation.

MORPHOLOGY

On the Host

MYCELIUM

The mycelium of the Cercosporae consists of very fine to coarse, fairly regular to very irregualr, septate hyphae which for the most part ramify the host tissue. Not infrequently, however, the mycelium is produced externally as well, and then the external threads take their origin in two ways. Usually they arise from the internal mycelium and emerge through the stomata, as in *C. condensata* Ell. & Kell. and *C. petersii* (B. & C.) Atk., but they may also arise directly from the conidiophores, as in *C. portoricensis* Earle. The latter procedure is not common.

In color, the mycelium varies from hyaline or subhyaline, as in *C. acalyphae* Peck, to olivaceous or olive-brown, as in *C. tuberosa* Ell. & Kell. Usually it varies from hyaline or subhyaline to some shade of brown, as in *C. apii* Fresen. The mycelium, when young, is as a rule colorless or only slightly colored. As it becomes older, it may remain so, or pigments may be produced so that the old mycelium not infrequently is a deep shade of brown.

Frequently, if not always, the old mycelium in the dead host tissue produces sclerotia-like bodies, or the cells of the mycelium thicken, become heavy-walled, and are transformed into chlamydospores or chlamydospore-like structures. These serve as a means of over-wintering the fungus.

When the fungus has advanced to the stage at which the asexual reproduction occurs, there are formed or already have been formed, at various points on the mycelium within the host tissue, more or less compact bodies, or stromata. The stroma may consist of a large, compact, tuberculate, pseudoparenchymatic structure, as in *C. smilacina* Sacc. (Fig. 10) and *C. tuberosa* Ell. & Kell. (Fig. 12). More commonly, however, it is made up of rather loosely to fairly compactly interwoven hyphae not of a pseudoparenchymatic nature, e.g., *C. apii* Fresen. (Fig. 1) and *C. cercidicola* Ell. (Fig. 5). In some cases the stroma may be almost completely lacking or made up of only a few more or less loosely associated cells, e.g., *C. ferruginea* Fckl. (Fig. 6) and *C. acalyphae* Peck (Fig. 2). Intermediate forms of all degrees exist between the types just cited.

CONIDIOPHORES

The conidiophores arise from the stromata described above and emerge from the host tissue either through the stomata or by rupturing the epider-

mis. Both types of emergence may be found in a single species, the point at which the conidiophores emerge apparently being largely determined by the position of the stroma. When a species produces an external mycelium, the conidiophores may also be produced in an effuse manner on it, e.g., *C. portoricensis* Earle (Fig. 13).

The number of conidiophores arising from a single stroma may be few or many. As a result, they are produced in loose to dense, more or less divergent tufts. In *C. cercidicola* Ell. (Fig. 5) and *C. petersii* (B. & C.) Atk. (Fig. 11) the tufts are coremioid. Rarely are the conidiophores solitary, and in no case have they been observed to be so throughout. In *C. carotae* (Pass.) Solheim, they are sometimes solitary but they are also produced in very loose tufts.

Considerable variation exists in the size, markings, and color of the conidiophores. They may be continuous or septate, straight or flexuous, geniculate, denticulate, hyaline or of various shades and tints of brown up to blackish-brown. The denticulations, geniculations, and flexuous conditions are produced by the manner of growth of the conidiophores while bearing conidia. The conidia are borne acrogenously, although at times they appear lateral because of the development of a lateral branch just below the point of attachment, which pushes the terminal point of the conidiophore to the side, while the conidium is still attached. The branch soon proceeds to develop another conidium, and a single conidiophore may continue to develop in this manner, producing several conidia. The general shape and markings of the conidiophore are dependent on the degree to which the branch succeeds in pushing the apical point of conidial attachment to the side, and on the rate of growth of the conidiophore as compared with the rate of production of conidia. If the apex with its scar is completely turned to one side, the conidiophore will be nearly cylindrical, with scars distributed along its sides. The scar may not be much displaced and the branch then diverges from the general direction so as to produce a geniculation, the scar being shouldered. When a second conidium is produced, the next branch usually arises on a different side, most frequently the opposite side; consequently, the divergence is in a different direction, giving a somewhat zigzag appearance. At times, the branch is set a little below the apical scar, so that the scar, when pushed to the side, becomes denticulate.

The conidiophore, as a result of this type of branching, is sympodial. Such a conidiophore is usually spoken of as being simple when pertaining to this group of fungi. Besides this sympodial branching, monopodial branching is also found in many species, e.g., *C. ferruginea* Fckl. (Fig. 6). Only a few of the conidiophores of a given species may produce this latter type of branch, but in other species a very high percentage may be thus branched. Usually there is no definite arrangement of the monopodial branches. Most

commonly they are irregularly alternate. More rarely they are opposite, being subtended by a terminal condidial scar, e.g., *C. cercidicola* Ell. (Fig. 5). Again, they may be both alternate and opposite as in *C. illinoensis* Barth. (Fig. 8).

CONIDIA

The conidia of Cercospora are of several distinct morphological types. Certain species, e.g., *C. acalyphae* Peck (Fig. 2), have conidia of which the point of attachment is as wide as the greatest diameter of the conidium. From or near the base, the conidium gradually tapers to the tip. For this type the term acicular is suggested. In other species, the point of attachment is narrower than the greatest diameter. These are termed acicular-obclavate or narrowly obclavate if they taper gradually as in the above type, e.g., *C. smilacina* Sacc. (Fig. 10), or merely obclavate or abruptly obclavate if there is an abrupt tapering directly above the greatest diameter, e.g., *C. ferruginea* Fckl. (Fig. 6). In the last two types, the greatest diameter of the conidium is very near its base. If the greatest diameter is at or near the center, the conidia are fusiform as in *C. pastinacae* (Sacc.) Peck (Fig. 14). In other species the conidia are cylindrical, e.g., *C. althaeina* Sacc. (Fig 3).

The conidium, in its development, first appears as a small, oval, elliptical, clavate or cylindrical body. As it grows, it elongates and assumes one of the forms described above. The conidia are usually borne singly but may be catenulate, as in *C. catenospora* Atk. They are usually septate and may or may not be constricted at the septa. They are straight or curved and vary in color from hyaline or subhyaline to various shades and tints of yellow or brown, such as olive-brown, Dresden brown and Prout's brown.

In Culture

In pure culture, individual Cercospora species react quite differently. Duggar (1899), working with *C. beticola* Sacc., found that it did not produce conidia in culture on artificial media. The same has been observed for *C. concors* (Casp.) Sacc. by Jones and Pomeroy (1907), for *C. fusca* Rand by Rand (1914), for *C. bolleana* (Thüm.) Speg. by Higgins (1920) and for *C. lythracearum* Heald & Wolf by Wolf (1927). Garman in 1920 found that *C. brunkii* Ell. & Galw. grew well on several media but that it did not readily produce conidia. On the other hand, several other species have been shown to produce conidia abundantly in culture. Among these are *C. personata* (B. & C.) Ell. cultured by Wolf (1914), *C. medicaginis* Ell. & Ev. studied by Hopkins (1921), *C. apii* Fresen., studied by Klotz (1923), *C. microsora* Sacc. studied in culture by Klebahn (1918) and several Philippine species cultured by Welles (1925). All of the above workers

found that the particular species grew on most media tried, and all, with the exception of Welles, report growth as being slow, only a few millimeters or at most a few centimeters growth being produced in several weeks. Welles, on the other hand, reports very rapid growth in artificial culture for the five species studied by him.

In the present investigation, attempts were made to artificially culture various species of Cercospora. Only two species, however, were isolated that produced conidia on artificial culture media. These were *C. ampelopsidis* Peck and *C. illinoensis* Barth. Other fungi, supposedly Cercospora species, were isolated from various hosts, but because they failed to produce conidia their identity could not definitely be determined without infection studies which circumstances did not permit.

The two species that were isolated grew on all media tried. The media employed were selected with the view of varying the carbohydrates to observe any effects this might have on the morphology and color. Several standard synthetic media were, therefore, used as well as some specially prepared. A chemical base agar was made up according to the formula given by Stevens and Hall (1909). This was used alone or in combination as follows: chemical base agar + glucose, chemical base agar+starch, and chemical base agar+sodium asparaginate. Besides these media potato dextrose agar, bean pod agar, corn meal agar, and agar were used.

The morphology of *C. ampelopsidis* Peck in culture varied little from that in the host. In both cases a rather fine and a coarse beaded mycelium was produced. However, in culture a much greater amount of the coarse beaded type was produced than in the host. It is quite possible that this difference is due to the age of the specimens examined as compared with the age of the cultures. A physiological old age may possibly be reached much sooner in culture than in the host, due to attendant conditions. The cells of the coarse mycelium were chlamydospore-like and perhaps are the means by which this fungus overwinters. The conidiophores do not differ essentially in the two cases. The most striking difference was found in the conidia. In artificial culture they were catenulate, whereas they are not so in nature. Their shape is somewhat altered in culture, due to this fact, the conidia in culture being subcylindrical, while in nature they are abruptly obclavate.

The growth of this fungus in culture was rather slow, being most rapid on potato dextrose agar. No striking differences were noted in the morphology on the various media. The finer mycelium was much the same throughout. The coarse mycelium varied somewhat, being decidedly beaded on some media and not so on others. On the chemical base agar+glucose, much thicker cell walls were produced in the coarse mycelium than on any of the other media. The conidiophores were much the same throughout but were rather poorly developed on the chemical base agar +glucose. On

this agar, conidial production was also rather limited and the conidia were rarely catenulate. The color of the fungus varies considerably with age. When young the various structures are hyaline to subhyaline. As the fungus becomes older, pigments are produced which are of various shades of brown, olive-brown and olivaceous, depending somewhat on the medium. While the color varied somewhat in intensity on the different media these differences were not very pronounced. The coloring material was in part diffused throughout the medium.

The conidiophores arose only from the submerged mycelium. They were readily distinguished from the mycelium, appearing as definite morphological units.

C. illinoensis Barth. grew most rapidly on potato dextrose agar and on corn meal agar, from the standpoint of colony diameter. However, if density of growth is also considered, then growth was best on potato dextrose agar.

Some variability in the mycelium occurred in the different media, especially from the standpoint of the production of a coarse, irregular, heavy-walled mycelium which was produced only in some of the media. Conidiophores and conidia were produced abundantly on all media except potato dextrose agar and chemical base agar+starch. The conidiophores arose from the submerged mycelium only. Conidia were produced most abunddantly in pure agar. They also appeared to vary less in size and irregular constriction in the latter medium than was the case in the other media. Considerable variability in color was noted on the various media. The color variation was primarily one of degree, varying from dilute light olivaceous to dark Prout's brown. The darkest color was produced on the corn meal agar and chemical base agar+glucose. The coloring material was not confined to the fungus hyphae but was diffused throughout the medium as well.

No striking differences were noted in the morphology of this fungus in pure culture and in the morphology on the host. The conidia in culture were more nearly cylindrical than in nature. The conidiophores appear in general to be effused in culture. While they were loosely tufted in potato dextrose agar they were abnormal and only sparingly produced, so that this condition is perhaps not normal. Other differences were of no importance.

From the cultural studies here made, it is indicated that Cercospora species that complete their life-cycle in pure culture do so in a similar manner as in nature with very little variation in morphologic structure. Welles (1925) in his culture studies of several Cercospora species, states that the conidiophores are merely extended mycelial threads and that it is impossible to distinguish them from the mass of mycelium in pure culture. In the present case, no difficulty was found in distinguishing the conidio-

phores in pure culture of the two species studied. They may, at times, be rather difficult to observe, due to the abundance of mycelium which tends to obscure them. That the conidiophores of Cercospora are definite morphological units is also borne out by the fact that in nature, when they are effused on an external mycelium, they are quite distinct, and conidial production is limited to these structures. The conidia, in these cases, are not produced in a haphazard manner on the external mycelium.

Klotz (1923) in his culture study of *C. apii* Fresen. states that the pigment produced by this fungus was confined to the hyphal threads. This is apparently not the case with all Cercosporae, as in the two studied here the coloring material was diffused through the medium as well.

That color is of little value as a taxonomic character with respect to this group of fungi where differences in color consist primarily in a difference in intensity of a series of browns, is indicated by the comparative ease with which it may be varied by employing different culture media. Color may, however, be fairly constant under different conditions, as only slight variations were produced in *C. ampelopsidis* Peck. On the other hand, wide variations in color were produced in *C. illinoensis* Barth. in the different media.

LIFE HISTORY

The Cercosporae are, for the most part, leaf parasites which produce definite, necrotic spots. Not in all cases, however, is their growth limited to the leaves. Frank (1897) states that *C. beticola* Sacc. grows on all parts of the beet plant that are above the soil. Other examples are *C. medicaginis* Ell. & Ev. which grows on the leaves, leaf petioles and seeds of *Medicago maculata* Willd., *C. acalyphae* Peck growing on the leaves and stems of *Acalypha ostryaefolia* Riddel, *C. coffeicola* Berk. & Cooke growing on fruits, twigs and leaves of *Coffea* sps., *C. caulicola* Wint. growing on the stems of *Asparagus officinalis* L., and *C. lythracearum* Heald & Wolf on fruits and leaves of *Punica granatum* L.

Infection of the host by the parasite is usually brought about, after the germination of the conidia, by infecting hyphae which gain entrance through the stomata. This type of infection has been observed for *C. beticola* Sacc. by Pool and McKay (1916) and for *C. apii* Fresen. by Klotz (1923). It has also been observed for several of the species studied in this investigation.

With respect to the manner of conidial germination Atkinson (1891) states as follows: "The conidia germinate readily in an abundance of moisture, a germ tube being put forth by any or all the cells. In my observations, and they have extended over several species, usually the cell first to produce a germ tube is the basal cell, and the primary direction of this tube is in a line parallel with that of the conidium but in an opposite direction from the apex. This is not universal, but occurs in such a great majority of the cases as to be worthy of note." This manner of germination has also been observed to be most prevalent for the species in which germination of conidia was seen in this study. A notable exception occurred in *C. sordida* Sacc. In several of the specimens of this fungus that were examined, germinating conidia were present in great abundance. The conidia germinate at any point. If the conidia, however, happened to be lying over the stomata or just at the side of a stoma, then the germ tube always arose from the point closest to the stoma. In this species and in *C. smilacis* Thüm. conidia were observed occasionally to produce conidiophores as a direct result of their germination.

The Cercospora parasite, as it penetrates the host tissue, in most cases causes the death of the affected part. Its action, however, is more or less limited, and the result is usually the production of a definite spot, the size

of which depends largely upon the efficiency of the host in combating it or upon the ability of the fungus to overcome mechanical obstructions such as veins. Several of these spots may be present, their form varying from circular to angular to irregular. They are variously colored. In some cases the spots are indefinite, the fungus being diffused in patches over the leaf surface.

After a period of incubation, conidiophores and conidia are produced. This period undoubtedly varies somewhat for the different species. Pool and McKay (1916a) have shown it to be from 11 to 13 days for *C. beticola* Sacc. The conidia produced at this time serve as a source of added infection and also for spreading the fungus. They are disseminated by wind, water, insects, etc.

Mycelium and sclerotia, in the old dead portions of the host, perhaps serve as the primary means of overwintering these fungi. This has been shown to be the case in *C. apii* Fresen. by Klotz (1923) and in *C. beticola* Sacc. by Pool and McKay (1916a). McKay and Pool (1918) have also shown that *C. beticola* Sacc. overwinters in the infected crowns of stored roots, or that the conidia may overwinter on the beet seed balls. Hopkins (1921) states that *C. medicaginis* Ell. & Ev. is borne as mycelium on the seeds within the burs. *C. personata* (B. & C.) Ell. according to Wolf (1916) overwinters on the leaves and seeds.

In the spring when conditions are suitable the overwintered mycelium and sclerotia produce conidiophores, the conidia of which serve as the means of infection of the new crop.

This, as far as is known, completes the life history of the majority of the Cercospora species. Some, however, are known to possess a Mycosphaerella perfect stage. These are:

C. cerasella Sacc. = *Mycosphaerella cerasella* Aderhold (1900).

C. microsora Sacc. = *Mycosphaerella millegrana* (Cooke) Schroet. The relationship was proven by Klebahn (1918).

C. bolleana (Thüm.) Speg. = *Mycosphaerella bolleana* Higgins (1920).

C. lythracearum Heald & Wolf = *Mycosphaerella lythracearum* Wolf. The relationship of these two forms is not absolutely proved. Wolf (1927) states: "The relationship of conidial and perithecial stage is evidenced (1) by their occurrence in due time in the same lesions, (2) by the similarity of cultures from conidia and ascospores, and (3) by the fact that a number of Cercosporas are known to possess a Mycosphaerella stage."

Several other connections with Mycosphaerella have been reported for various Cercospora species. None of these, however, have been proved. Of the forms above mentioned *C. bolleana* (Thüm.) Speg. and *C. lythracearum* Heald & Wolf produce spermagonia.

TAXONOMIC AFFINITIES

Cercospora, according to the system of classification now followed, belongs to the group of Fungi Imperfecti known as the Hyphomycetes or Moniliales. The main characterization of the genus has been based on the shape of the conidia, which are vermiform or filiform, and the presence of color in the conidiophores. This places the genus in the family Dematiaceae, which is separated from the Moniliaceae merely on a color basis. That this has led to an unnatural grouping is quite evident. Atkinson (1891) in discussing the affinities of Cercospora and Ramularia states: "Here we encounter one of the difficulties of the artificial system which exists to a great extent in the arrangement of some of the Hyphomycetes, where such genera as Ramularia and Cercosporella, structurally very closely related to Cercospora, are made to do duty in an entirely different family."

If the color barrier which now separates the Moniliaceae from the Dematiaceae, and thus separates these genera, were to be removed and the two families constituted as one family (the Moniliaceae), what would happen? In the first place, genera morphologically closely related, but by the present system widely separated, would fall into more natural groups. In several instances it would undoubtedly result in the consolidation of now separate genera. This step of eliminating color as a primary division character was suggested by von Höhnel in 1923. In his system, covering the Sphaeropsidales, Melanconiales, Stilbaceae, and Tuberculariaceae, color as a character has been used only secondarily.

That color is not constant, and therefore an unreliable character, has been shown by several workers. Stevens (1922) and Ravn (1900) have noted variations in color in Helminthosporium species when grown on various media. Young and Bennett (1922) found that *Fusarium radicicola* Woll. was colorless in Richard's solution and pink in the same solution when the potassium nitrate was replaced by calcium nitrate. Bessey (1904) produced changes in color in Fusarium species by varying the hydrogen ion concentration of the medium. Similarly, Milburn (1904) varied the color of several Hypocrea species. He also changed the color of these fungi by varying the osmotic value of the medium. Milburn further showed that *Aspergillus niger* van Tieg. produced a yellow pigment which in the light quickly became gray or black. Stevens and Hall (1909), by varying the carbohydrates of the media employed, secured marked changes in the color of various fungi. In *Volutella fructi* Stev. & Hall sufficient differences

were secured to shift the fungus from the Tuberculariaceae-Dematiaceae to the Tuberculariaceae-Mucedinae. *Colletotrichum carica* Stev. & Hall varied from pale to almost black. Several Epicoccum species were colorless on certain media while on other media they were yellow, pink or sometimes black. *Alternaria brassicae* (Berk.) Sacc. varied from hyaline to black on the different media. Similar changes in color to those noted above have been observed in Cercospora species by Jones and Pomeroy (1907), Rand (1914), Garman (1920) and Klotz (1923). In the present investigation, as previously stated, the color of *Cercospora illinoensis* Barth. varied from pale to dark brown on different media.

All of these studies clearly show that color can have little value as a character to be used in the classification of this group of fungi. This is further attested for by Arnaud's (1923) procedure, when he proposed the group "Septiodiées" of the Hyphomycetes to contain the genera Diploidium and Septoidium, as these genera will not fit into the Moniliaceae nor the Dematiaceae, for these fungi may be colored or hyaline in the same species and they include types which are not separable genetically. That color is of little value is further indicated by Ellis and Everhart (1885) who have listed six species of Cercospora with hyaline conidia and conidiophores. Again, von Höhnel (1903) shows that the color line has also been ignored with respect to Ramularia, and he enumerates 17 species from the Sylloge Fungorum which have colored conidiophores.

From the foregoing, the conclusion is inevitable that color can not be used as a primary character for the separation of families or even of genera in this group of fungi. It is, therefore, proposed to unite the Moniliaceae and Dematiaceae and consolidate as much as possible the forms of the two families. Only Cercospora and closely related forms are considered here.

With the color barrier removed, but adhering to the system as employed within the families, we find that the genera Cercospora, Cercosporella, and Ramularia all fall into one group covering two sections of the system, the Phragmosporae and the Scolecosporae. These two sections are not readily separated. To illustrate: Saccardo in 1886 placed the genus Cercospora in the Phragmosporae, but in 1899 he transferred it to the Scolecosporae. Lindau in 1900 placed the genus in the Scolecosporae, but in 1910 he put it in the Phragmosporae. Clements (1909) evaded this difficulty by placing the genus in both sections.

Turning to Ramularia and Cercosporella, we find that these genera have been placed in the Phragmosporae and Scolecosporae, respectively, thus on the basis of their conidia falling into the same sections as Cercospora. Further comparisons reveal that Cercosporella at least is not morphologically distinct from Cercospora. When establishing the genus Cercosporella, Saccardo (1880) states that it is a Cercospora with hyaline

conidia and conidiophores. It is, therefore, proposed to unite Cercosporella with Cercospora.

A rather unfortunate situation exists with respect to the status of Ramularia and Ovularia. Ramularia was established by Unger in 1833. He, however, did not describe the genus but simply listed two species, *R. pusilla* Ung. and *R. didyma* Ung. Corda in 1842 removed the second species from Ramularia and made it the type of a new genus, Didymaria [*D. didyma* (Ung.) Schroet. = *D. ungeri* Corda]. This leaves *R. pusilla* Ung. as the type of Ramularia. Saccardo in 1881 ignored this fact and put this species in the genus Ovularia (*O. pusilla* (Ung.) Sacc.), a genus which he had established in 1880. From this it appears that the genus to properly bear the name Ramularia is what today is known as Ovularia and further that the group of species known as Ramularia has no proper generic name. It is, however, at present inadvisable to make this change in nomenclature. The species *R. pusilla* Ung., around which the question centers, is a very doubtful one, and it is impossible to clear up the problem without further studies.

Wollenweber's concept of Ramularia as set forth in 1913 appears at present to be untenable. He identified Ramularia with Septocylindrium, a genus apparently closely allied to Fusarium. Whether Ramularia in part is to be considered identical with Septocylindrium will depend upon the facts revealed in a study of *R. pusilla* Ung., a study which has not been made. Further, it is certain that many of the species now considered under Ramularia, as *R. tulasnei* Sacc., are not even closely related to Fusarium. A thorough study of this group of fungi is necessary to determine the ultimate status of the species involved.

The type species of Didymaria is *D. didyma* (Ung.) Schroet. This species (Fig. 16) is a Ramularia with two-celled clavate conidia. This conidial type is also found in Cercospora but is there atypical. It is, therefore, proposed to revise Didymaria so that it will include all species with conidiophores of the Cercospora type and producing clavate conidia with two or more cells. Here, then, would belong *Didymaria* (*Cercospora*) *effusa* (B. & C.) Solheim, n. comb. The status of the remaining species of Didymaria, with oval to obclavate conidia, can not at present be determined but must await the solution of the Ramularia-Ovularia question. As pointed out by Wollenweber and others, the separation of these forms on the basis of conidial septation is not justified.

Didymariopsis, established by Spegazzini in 1910, is described as a Didymaria with colored conidiophores. The type of this genus has not been seen. Following the procedure as set forth above, this will be synonymous with Didymaria if the conidia are clavate, or will fall into the group of excluded Didymariae, for the present left unattached.

Cercosporina, another genus established by Spegazzini in 1910, is a Cercospora with hyaline conidia. This genus, therefore, has occupied a position between Cercospora and Cercosporella. Since it was proposed to unite Cercosporella with Cercospora, it follows from the above that Cercosporina must also be united with Cercospora.

Cercosporidium Earle and Isariopsis Fresenius are genera also very closely allied with Cercospora and are perhaps not generically distinct. Further studies are, however, necessary to determine the final status of these genera as well as other related genera.

DIVISION OF CERCOSPORA INTO SECTIONS

In the genus Cercospora, the morphologic characters which have served to separate species are host reaction and size, shape, and color of conidia and conidiophores. The assumption has been that these characters are fairly constant under varying environmental conditions. If this assumption were true, it might be possible to subdivide the genus into sections based on the size of the condia and conidiophores.

To determine the value of size as a character for classification of this group of fungi, several specimens of *C. beticola* Sacc. were compared. The results are recorded in the following table:

Specimen No.	Length of Conidiophores in μ			Length of Conidia in μ		
	Minimum	Mode	Maximum	Minimum	Mode	Maximum
1	19.4	38.9	136.1	38.9	90.7	207.4
2	22.6	68.0	136.1			
3	22.6	38.9	71.3			
4	19.4	35.6	55.0	32.9	71.3	136.1

In the description of *C. beticola* Sacc. the length of the conidiophores is given as 40–60μ, suggesting that there is not a great range in their length. This, as is shown in the above table, is not in accord with the present findings. The conidiophores were found to vary in length from 19.4 to 136.1μ. The Saccardian description gives the variation in conidial length as 70–120μ. In the present case, the variation was found to be 32.9–207.4μ.

The unreliability of condial and conidiophore length has also been pointed out by Welles (1925) and Overholts (1927). Welles experimentally induced considerable variation in length of these structures in several Cercospora species by varying the humidity. He also showed that the size of the condia and condiophores, induced through artificial inoculation, varied greatly, depending on the host. The seasonal variation in size of these structures was also considerable. Overholts concludes from a study of Cercospora species on Smilax, that length of conidiophores is a character of little value.

These studies clearly indicate that division of the genus into groups on the basis of conidial and conidiophore length would be difficult and unreliable. Neither does division of the genus on the basis of the manner of

conidiophore emergence, as suggested by von Höhnel, appear to be feasible; for if it is determined by the nature of the host, as suggested by Lindau, rather than by any inherent quality of the fungus, the manner of emergence is hardly suitable or even valid as a basis for a division.

For convenience, morphologic characters may be grouped into two categories, those which are constant and those which are variable. Only those which are fairly constant are of much value. If all the characters of the Cercospora species were as variable as the length of the conidia and conidiophores, it would be difficult to divide the genus into groups or to recognize species. However, a comparison of over 100 species has revealed characters which, for the cases examined at least, appear to be fairly constant.

The contrasted characters revealed by the comparisons that appear to have a value as a basis for dividing the genus into sections are: (1) the presence or absence of an external mycelium; (2) conidiophores simple or branched; (3) conidiophores arising from a tuberculate stroma, a loose to fairly compact stroma, or non-stromatic; (4) conidia acicular-obclavate, abruptly obclavate, or cylindrical.

Of these sets of characters, the first two are most significant. The reason for this is that they involve the presence or absence of structural units. These characters are, therefore, used as primary division characters. The presence or absence of an external mycelium is used first. In the cases in which an external mycelium was observed, it was constant for all the specimens examined, and was present in sufficient quantity to make it easy to assign the fungus to a category based on its presence. A little greater difficulty arises with respect to the use of the presence or absence of branched conidiophores since in the transitional groups the branching is limited to a very small percentage of the condiophores, e.g., *C. beticola* Sacc. In this particular species, only 1.35 per cent of the conidiophores were branched. The question, therefore, arises as to how much branching is necessary in order that a species be grouped in a section characterized by branched conidiophores. Should as fine a distinction be drawn here as has been in regard to setae in Gloeosporium and Colletotrichum? Such a course appears to be ill-advised. It appears more useful to consider those species branched in which the character is consistently revealed upon careful search, even though the percentage be low. On the other hand, species in which only a single case of branching is observed, or species in which the percentage of branching is very low but does not occur regularly, are not considered as having branched conidiophores and are placed in the sections having simple conidiophores.

There are two types of branching, opposite and irregularly alternate. The former type is found in *C. cercidicola* Ell. (Fig. 5) and the latter in *C. ferruginea* Fckl. (Fig. 6). Both types are combined in *C. illinoensis*

Barth. (Fig. 8). Three groupings are, therefore, possible on the basis of branching.

The other sets of characters—conidiophores arising from a tuberculate stroma, or a loose to fairly compact stroma, or non-stromatic, and conidial shape—involve degrees of expression of single characters, and consequently there is considerable intergradation between the distinct types. They are, therefore, a little more difficult to use. However, in the specimens examined, they appear to be constant for single species, which makes it possible to employ them in a division of the genus.

The nature of the stroma and of the conidial types has been defined in the morphological discussion. Suffice it to state here that two groupings are possible on the basis of the nature of stromatic expression: (1) stroma tuberculate or pseudoparenchymatic and (2) stroma composed of loosely to fairly compactly interwoven hyphae or rarely none produced. While five types of conidia have been defined, only three groupings are possible under this heading. These are groups with species having cylindrical, abruptly obclavate, or acicular-obclavate conidia. The last group includes species with acicular conidia and narrowly obclavate conidia. These two types are not readily separable. Species having these two types of conidia are, therefore, grouped together as acicular-obclavate. In the first group are included species with fusiform conidia.

Using the characters above discussed, the species of the genus so far studied have been grouped into sections as shown in the following systematic arrangement of the genus.

SYSTEMATIC ARRANGEMENT OF THE GENUS

Cercospora Fresenius

Cercospora Fresenius, Beitr., 3:91, 1863.—Frank, Krank. d. Pfl., p. 600, 1880.—Saccardo, Mich., 2:29, 1880; Syll. Fung., 4:431, 1886.—Costantin, Les Mucedineès Simples, p. 77, 1888.—Lindau in Engler and Prantl, Nat. Pflanzenfam., 1:1:486, 1900; and in Rabenhorst's Kryptogamen-Flora, 9:86, 1910.—Massee, Diseases of Cultivated Plants and Trees, p. 483 1910.—Stevens, The Fungi which Cause Plant Disease, p. 625, 1921; Plant Disease Fungi, p. 413, 1925.

Syn. *Virgasporium* Cooke, Grev., 3:182, 1875.

Cercosporella Saccardo, in part, Mich., 2:20, 1880; Syll. Fung., 4:218, 1886.—Costantin, Les Mucedineès Simples, p. 74,, 1888.—Lindau in Engler and Prantl, Nat. Pflanzenfam. 1:1:451, 1900; and in Rabenhorst's Krytogamen-Flora, 8:421 1910.—Smith and Ramsbottom, Trans. Brit. Myc. Soc., 5:166, 1915.—Stevens, The Fungi which Cause Plant Disease, 592, 1921; Plant Disease Fungi, p. 395, 1925.

Cercosporina Spegazzini, in part, Myc. Arg., 5:424, 1910.—Saccardo, Syll. Fung., 22:1432, 1913.

Mycelium internal or in part external. Conidiophores tufted, emerging through the stomata, rupturing the epidermis, or in part effused on the external mycelium when the latter is present, simple or branched, more or less geniculate, straight or flexuous, continuous or septate, nonstromatic or arising from a loose to tuberculate stroma, hyaline to dark brown. Conidia acrogenous, at times appearing lateral due to the further development of the conidiophores, acicular, narrowly obclavate, abruptly obclavate, fusiform, or cylindrical, filiform, septate, hyaline to dark brown.

The type species is *Cercospora apii* Fresenius.

Key to Sections of Cercospora

I. Mycelium internal
  A. Conidiophores simple
    1. Stroma tuberculate
      a. Conidia acicular-obclavate ..... Section I
      b. Conidia abruptly obclavate ..... Section II
      c. Conidia cylindrical ..... Section III
    2. Stroma not tuberculate, composed of loosely to fairly compactly interwoven hyphae, or rarely none produced
      a. Conidia acicular-obclavate ..... Section IV
      b. Conidia abruptly obclavate ..... Section V
      c. Conidia cylindrical or somewhat fusiform ..... Section VI
  B. Conidiophores branched
    1. Branching opposite, stroma not tuberculate, composed of loosely to fairly compactly interwoven hyphae, or rarely none produced, conidia abruptly obclavate ..... Section VII
    2. Branching alternate
      a. Stroma tuberculate
        1. Conidia acicular-obclavate ..... Section VIII
        2. Conidia cylindrical ..... Section IX
      b. Stroma not tuberculate, composed of loosely to fairly compactly interwoven hyphae or rarely none produced, conidia cylindrical ..... Section X
    3. Branching alternate and opposite, stroma composed of loosely to fairly compactly interwoven hyphae, or rarely none produced, conidia cylindrical ... Section XI

II. Mycelium internal and external
  A. Conidiophores simple
    1. Stroma tuberculate
      a. Conidia acicular-obclavate ..... Section XII
      b. Conidia abruptly obclavate ..... Section XIII
      c. Conidia cylindrical ..... Section XIV
    2. Stroma not tuberculate, composed of loosely to fairly compactly interwoven hyphae, or rarely none produced
      a. Conidia acicular-obclavate ..... Section XV
      b. Conidia abruptly obclavate ..... Section XVI
  B. Conidiophores branched
    1. Branching alternate
      a. Stroma tuberculate, conidia abruptly obclavate ..... Section XVII
      b. Stroma not tuberculate, composed of loosely to fairly compactly interwoven hyphae, or rarely none produced
        1. Conidia acicular-obclavate ..... Section XVIII
        2. Conidia abruptly obclavate ..... Section XIX
        3. Conidia cylindrical ..... Section XX
    2. Branching alternate and opposite, stroma composed of loosely to fairly compactly interwoven hyphae, or rarely none produced, conidia cylindrical .. Section XXI

Section I

Mycelium internal, conidiophores simple, stroma tuberculate, conidia acicular-obclavate.

Cercospora lysimachiae Ellis and Halsted, Jour. Myc., 6:34, 1890.—Saccardo, Syll. Fung., 10:631, 1892.

Type locality: New Brunswick, N. J., B. D. Halsted, Sept. 1889, Ellis and Everhart, N. Amer. Fungi, Sec. Ser., No. 2475. Collected previously by B. D. Halsted, Jonesburg, N. J., July 1889.

Spots none. Mycelium internal, subhyaline to light greenish-yellow, very fine, 1.5–2.5μ, stromatic mycelium yellowish-brown to dark brown, 3–7.5μ. Conidiophores amphigenous but mostly hypophyllous, densely tufted, the tufts being effused over the leaf surface, emerging through the stomata, simple, or very rarely with short irregular branches, subflexuous to flexuous, spreading, arising from a tuberculate stroma, Sudan brown, 25–90×4–6μ, continuous or 1–4 septate, somewhat irregularly constricted at septa, conidial scars rather indistinct. Conidia narrowly obclavate to acicular, dilute yellowish to yellowish-brown, 35–175×2.5–4×1.5–2.5μ, continuous or obscurely 1–15 septate.

On leaves of **Lysimachia stricta* Ait.

Specimens examined: Ellis and Everhart, N. Amer. Fungi, Sec. Ser., No. 2475 (type) (New Brunswick, N. J.).

Cercospora smilacina Saccardo, Mich., 2:364, 1880; Fungi Ital., Pl. 681, 1881; Syll. Fung., 4:476, 1886.—Lindau, in Rabenhorst's Kryptogamen-Flora, 9:799, 1910.

Type locality: Collioure, France, O. Debeaux.

Spots amphigenous, circular to somewhat angular, more or less vein-limited, at times confluent, 1–4 mm., dark brown, with a slight reddish tint above; border definite, raised, blackish-brown on inner margin, light brown to brown on outer margin, or frequently of the same color as the spots below, 150–300μ, the whole surrounded by a narrow yellowish discolored area. Mycelium internal, irregular, olivaceous to olive-brown, 3–10μ, forming here and there compact stromatic mats. Conidiophores amphigenous, densely to very densely tufted, rupturing the epidermis,

* Starred names indicate hosts on which the fungus has been seen by the writer.

with a bulbose base, simple, straight to subflexuous, arising from a large, compact, tuberculate stroma, Dresden brown, 15–55×4–4.5μ, continuous or 1–2 septate, conidial scars distinct, more or less shouldered, scattered. Conidia at first cylindrical, then narrowly obclavate, light olive-brown, 25–100–160×3–4×2–3μ, 1–13 septate. [Fig. 10]

On leaves of **Smilax aspera* L.

The above description agrees very well with that of Saccardo with the exception of the size of the conidia. In the Krypt. Exs. specimen No. 728b the conidia agreed very well with the measurements given by Saccardo. Only a few of the longer ones listed above were found. In the same exsiccati, specimen No. 728a, the longer conidia were more abundant than the shorter ones.

This species is closely allied to *C. smilacis* Thüm. but differs from it in the shorter, narrower, and unbranched conidiophores and in the more definitely attenuated conidia. From *C. petersii* (B & C.) Atk. it differs in its much shorter and narrower conidiophores and much narrower conidia. The conidia of the latter taper abruptly, those of *C. smilacina* Sacc. taper gradually.

Saccardo lists *C. smilacis* Peck as a synonym of his species. Peck, however, has no such species. The fungus described by Peck was listed under *C. smilacis* Thüm. and is now referred to *C. petersii* (B. & C.) Atk. (l.c.).

Migula's specimen listed below appears to belong here. The material was such, however, that this could not be determined with absolute certainty.

Specimens examined: Krypt. Exs., Nos. 728a (Abbazia, Litoriale austriacun), and 728b (Lussinpiccola, Lussin Island.)—Migula, Crypt. Ger., Aust. et Helv. Exs., Fasc. 33. Pilze. No. 179 (Abbazia, Istria).

Cercospora gaultheriae Ellis and Everhart, Jour. Myc., 2:2, 1886. On *Gaultheria procumbens* L., Ellis and Everhart, N. Amer. Fungi, Sec. Ser., No. 1514 (Newfield, N. J.).

Cercospora occidentalis Cooke, Hedw., 17:39, 1878. On *Cassia occidentalis* L., Ellis, N. Amer. Fungi, No. 642 (Aikin, S. Car.)

Cercospora ticinensis Briosi and Cavara, I Funghi Parass., No. 336, 1900. On *Sambucus nigra* L., (type) (Pavia, Italy).

Cercospora vernoniae Ellis and Kellerman, Am. Nat., 17:1116, 1883. On *Vernonia baldwinii* Torr., Ellis and Everhart, N. Amer. Fungi, Sec. Ser., No. 3090 (Rockfort, Kan.).

Cercospora zinniae Ellis and Martin, Jour. Myc., 1:20, 1885. On *Zinnia pauciflora* L., Ellis and Everhart, N. Amer. Fungi, Sec. Ser., No. 1507 (type) (Green Cove Springs, Fla.).

Cercospora zonata Winter, Bol. Soc. Brot., 2:49, 1883. On *Vicia faba* L., Rabenhorst-Winter, Fungi Europaei, Ser. II, No. 3294 (Coimbra, Italy).

Section II

Mycelium internal, conidiophores simple, stroma tuberculate, conidia abruptly obclavate.

Cercospora desmanthi Ellis and Kellerman, Jour. Myc., 3:14, 1887—Saccardo, Syll. Fung., 10:641, 1892.

Syn. *Cercospora condensata* Ellis and Kellerman, var. *desmanthi* Ellis and Kellerman, Jour. Myc., 1:2, 1885.—Saccardo, Syll. Fung. 4:436, 1886.

Type locality: Great Bend, Kansas, W. A. Kellerman, 1884.

Spots amphigenous, brown to blackish-brown, appearing as minute dark punctiform dots due to the abundance of condiophores which practically cover the spots. The whole leaflet eventually is killed and turns brown. Mycelium internal, light olivaceous to olive-brown, 2–5μ, stromatic mycelium of the same color but somewhat coarser, up to 8μ. Conidiophores amphigenous but mostly hypophyllous, very densely tufted, the tufts closely aggregated and only a few to each spot, rupturing the epidermis, simple, subflexuous to flexuous, arising from a short flattened, somewhat loose to compact, tuberculate stroma, dilute Dresden brown to dilute olive-brown, 35–80×3.5–5.6μ, 1–4 septate towards bases or in region below the surface of the host, conidial scars distinct, more or less shouldered. Conidia abruptly obclavate, light yellowish-olive to buffy olive, 15–40×5.6-6.4×2.5–4μ, continuous or 1–3 septate.

On leaves of **Desmanthus illinoensis* (Michx.) MacM.

Specimens examined: Ellis and Everhart, N. Amer. Fungi, Sec. Ser., No. 1992 (Manhattan, Kan.).

Cercospora fraxini (DeCandolle) Saccardo, Syll. Fung., 4:471, 1886. On *Fraxinus excelsior* L., Roumeguère, Fungi Sel. Gallici Exs., No. 5692. (Noidan, Côte-d'Or, France).

Cercospora personata (Berkely and Curtis) Ellis, Jour. Myc., 1:63, 1885. On *Arachis hypogaea* L., Ellis and Everhart, N. Amer. Fungi, Sec., No. 2480 (Starkville, Miss.).

Cercospora viticola (Cesati) Saccardo, Syll. Fung., 4:458, 1886. On *Vitis* sp., Briosi and Cavara, I Funghi Parass., No. 114 (Tenn.)

SECTION III

Mycelium internal, conidiophores simple, stroma tuberculate, conidia cylindrical.

Cercospora bupleuri Passerini, in Thümen, Myc. Univ., No. 1375. 1879.—Saccardo, Syll. Fung., 4:442, 1886.—v. Höhnel, Ann. Myc., 1:530, 1903.—Lindau, in Rabenhorst's Kryptogamen-Flora, 9:126, 1910,

Type locality: Parma, Vigheffio, Italy, Passerini, Sept. 1878, Thümen, Myc. Univ., No. 1375.

Spots amphigenous and caulicolous, circular to elliptical, 1–5×0.5–2 mm., reddish-brown on stems, becoming yellowish to white centered, on leaves reddish-brown to dirty-brown, becoming light centered; border definite, dark brown. Mycelium internal, subhyaline, 2.5–4.5μ, stromatic mycelium yellowish-brown to olive-brown, 2.5–6.5μ. Conidiophores amphigenous and caulicolous, moderately to densely tufted, rupturing the epidermis, simple, flexuous, arising from a somewhat loose to compact tuberculate stroma, dilute brownish-olive, 15–45×2.5–4.5μ, at times much inflated at bases, up to 7.5μ, continuous or 1–2 septate at bases; conidial scars minute but distinct, shouldered, scattered. Conidia oblong-cylindrical to bacilliform, tapering very slightly, straight or somewhat curved, subhyaline to light yellowish, 20–65×2–3.5×2–3μ, continuous or 1–3–5 septate.

On leaves and stems of **Bupleurum tenuissimum* L.

Specimens examined: Thümen, Myc. Univ., No. 1375 (type) (Vigheffio, Parma, Italy).

Cercospora tuberosa Ellis and Kellerman, Bull. Tor. Bot. Club, 11:116, 1884.—Ellis and Everhart, Jour. Myc., 1:38, 1885.—Saccardo, Syll. Fung., 4:439, 1886.

Syn. *Cercospora glaucescens* Winter, Rabenhorst-Winter, Fungi Europaei, Ser. II, No. 3080, 1884; Hedw., 23:171, 1884.

Spots amphigenous, irregular, often confluent, vein-limited, 0.5–3 mm., at first dark brown above and glaucescent below, becoming light rusty-brown to whitish; border indefinite. Mycelium internal, subhyaline to olivaceous to olive-brown, 1.5–6μ, stromatic mycelium olive-brown, 3–9μ. Conidiophores hypophyllous, rarely epiphyllous, moderately to densely tufted, emerging through the stomata, simple, straight to subflexuous, arising from a large tuberculate stroma, olive-brown, 35–80×3–5μ, 1–5 septate, conidial scars indistinct. Conidia oblong-cylindrical, slightly attenuated towards apexes, yellowish to pale olivaceous, 35-140-190×3.5-5×3-4μ, 3-15-20 septate, slightly or not at all constricted at septa. [Fig. 12.]

On leaves of **Apios tuberosa* Moench.

Specimens examined: As *C. tuberosa* Ell. and Kell., Bartholomew, Fungi Columb., No. 2614 (Wood River, Neb.). As *C. glaucescens* Wint.

Rabenhorst-Winter, Fungi Europaei, Ser. II, No. 3080 (Perryville, Mo.).

Cercospora destructiva Ravenel, Jour. Myc., 3:13, 1887. On *Euonymus japonicus* L., Ellis and Everhart, N. Amer. Fungi, Sec. Ser., No. 1760 (Aiken, S. Car.).

Cerospora hypophylla Cavara, Rev. Myc., 21:103, 1899. Pl. CXCVII, figs. 9, 10. On *Rosa canina* L., Briosi and Cavara, I Funghi Parass., No. 335 (Vallombrosa, Italy).

Cercospora platanicola Ellis and Everhart, Jour. Myc., 3:17, 1887. On *Platanus occidentalis* L., Ellis and Everhart, N. Amer. Fungi, Sec. Ser., No. 1766 (Point a la Hache, La.).

Cercospora protearum Cooke, Grev., 12:39, 1883. On *Leucospermum conocarpum* R. Br., Rabenhorst-Winter, Fungi Europaei, Ser. II, No. 3589 (Bonae Spei, Hottentot, Holland).

Section IV

Mycelium internal, conidiophores simple, stroma composed of loosely to fairly compactly interwoven hyphae, or rarely none produced, conidia acicular-obclavate.

Cercospora acalyphae Peck, 34 Rep. N. Y.State Mus., p. 48, 1881.—Ellis and Everhart, Jour. Myc., 1:20, 1885.—Saccardo, Syll. Fung., 4:457, 1886.—Atkinson, Jour. Eli. Mitch. Sci. Soc., 8:46, 1891.—Carver, Proc. Ia. Acad. Sci., 8:162, 1900.—Davis, Trans. Wis. Acad., 14:95, 1903.—Schwarze, N. J. Ag. Exp. Sta. Bull., 313:128, 1917. figs. 771–772.

Type locality: Albany, New York.

Spots amphigenous, circular to somewhat irregular, rarely confluent, small, about 0.3–3 mm., at first brown, then brownish-white to grayish-white above, brown, light-brown, to grayish-brown below; border definite, slightly raised, dark-brown to purplish-brown, 110–250μ, the whole at times surrounded by a narrow, yellow translucent area. Mycelium internal, regular to sub-irregular, much branched, hyaline to subhyaline, 1.5–3μ. Conidiophores amphigenous, mostly epiphyllous, frequently absent from the lower surface of the spots, loosely tufted, rupturing the epidermis or emerging through the stomata, simple, straight to subflexuous, non-stromatic to stromatic, Brussels brown to olive-brown, the color much diluted towards the apices, 20–200$\times$3.5–5μ, continuous to 1–3 septate, conidial scars distinct, aggregated towards the tips or scattered. Conidia acicular, hyaline, subhyaline to yellowish-green, 35–200$\times$2–3$\times$1.5–2μ, 2–15 closely septate. [Fig. 2.]

On leaves of **Acalypha virginica* L., *A. gracilens* Gray, and leaves and stems of *A. ostryaefolia* Riddel.

Specimens examined: Ellis and Everhart, N. Amer. Fungi, Sec. Ser., No. 1523 (Manhattan, Kan.); Fungi Columb., No. 694 (Nuttallburg, W.

Va.).—Seymour and Earle, Ec. Fungi, No. 382 (Millstone, N. J.).—Herb. Univ. of Ill. *ex* Herb. of F. L. Stevens, specimen collected at New Brunswick, N. J., Aug. 6, 1892.

Cercospora acnidae Ellis and Everhart, Proc. Acad. Nat. Sci. Phil., 1891, p. 89.—Saccardo, Syll. Fung., 10:637, 1892.

Type locality: Wilmington, Del., A. Commons, No. 1011, Sept. 1889. Prototype, Ellis and Everhart, N. Amer. Fungi, Sec. Ser., No 2582, Wilmington, Del., A. Commons, Sept. 1890.

Spots amphigenous, circular to somewhat angular, more or less vein-limited, 1–3 mm., brownish to dirty white; border definite, raised, dark brown, 150–500μ. Mycelium internal, hyaline to dilute yellowish-brown, 2–7.5μ. Conidiophores amphigenous, loosely to fairly densely tufted, rupturing the epidermis, simple, straight to subflexuous, arising from a loose to fairly compact stroma, olivaceous to Dresden brown, 25–75×3.5–5.5μ, continuous or 1 septate, conidial scars fairly distinct. Conidia narrowly obclavate, hyaline to light greenish-yellow, 20–75×3–4×1.5–2.5μ, 1–10 septate.

On leaves of **Acnida cannabina* L.

Specimens examined: Ellis and Everhart, N. Amer. Fungi, Sec. Ser., No. 2582 (prototype) (Wilmington, Del.).

Cercospora ageratoides Ellis and Everhart, Jour. Myc. 5: 71, 1889.—Saccardo, Syll. Fung., 10: 627, 1892.—Tracy and Earle, Miss. Agric. Exp. Sta. Bull., 34: 116, 1895.—Schwarze, N. J. Agric. Exp. Sta. Bull., 313: 128, 1927. fig. 773.—Davis, Trans. Wis. Acad., 19: 2: 675, 1919.

Type locality: Newfield, N. J., July to September 1885.

Spots indefinite, the tufts of conidiophores forming more or less vein-limited, olivaceous to Brussels brown, velvety patches on both surfaces of the leaves but especially on the lower surface. Mycelium internal, hyaline, 1–2.5μ; stromatic mycelium 2–6μ. Conidiophores amphigenous, loosely to moderately tufted, emerging through the stomata, subflexuous, subundulate, simple, or rarely irregularly branched, arising from a small, fairly compact stroma, Brussels brown to Argus brown, 20–90×4.5–5μ, 1–5 irregularly septate, at times somewhat constricted at septa, conidial scars fairly distinct, more or less warty, rarely shouldered. Conidia cylindrical to narrowly obclavate, yellowish-olive, 30–160×3–4.5×1.5–2.5μ, 1–13 septate.

On leaves of *Eupatorium urticaefolium* L., **E. album* L., and *E. rotundifolium* L.

Specimens examined: Ellis and Everhart, N. Amer. Fungi, Sec. Ser. No. 2473 (Newfield, N. J.).

Cercospora alismatis Ellis and Holway, Jour. Myc., 1: 63, 1885.—Saccardo, Syll. Fung., 4: 478, 1886.

Type locality: Decorah, Iowa, E. W. D. Holway, July.

Spots amphigenous, subcircular to irregular, somewhat confluent, more or less vein-limited, margin undulate, 4–10 mm., dirty brown above, olive-brown below, becoming grayish centered; border indefinite. Mycelium internal, almost regular or irregular, subhyaline to very dilute Dresden brown, 2–7.5μ, stromatic mycelium Dresden brown, somewhat penicillioidly branched. Conidiophores amphigenous, loosely to moderately tufted, emerging through the stomata, simple or very rarely irregularly branched, straight or flexuous, arising from a loose to compact stroma, Dresden brown, 40–250$\times$4.5–6μ, 1–7 septate, conidial scars distinct, scattered, shouldered or laterally displaced. Conidia narrowly obclavate, subhyaline to light greenish-yellow, 50–180–265$\times$3–5$\times$1.5–3μ, 4–10–21 septate.

On leaves of **Alisma plantago-aquatica* L.

Specimens examined: Ellis and Everhart, N. Amer. Fungi, Sec. Ser., No. 3191; Fungi Columb., No. 597.—Herb. Univ. of Ill. *ex* Crypt. Herb. of F. L. Stevens, No. 80 (All from Cicero, N. Y.).

Cercospora alternantherae Ellis and Langlois, Jour. Myc., 6: 36, 1890.—Stevens, Trans. Ill. Acad. Sci., 10: 211, 1917.

Type locality: St. Martinsville, Louisiana, Langlois, No. 1430.

Spots amphigenous, circular, rarely confluent, more or less convex above and concave below, dull-brown to olive-brown, becoming grayish to whitish centered, 0.5–2 mm. in diameter; border definite, raised, brown to dark-brown, 75–225μ, the whole surrounded by a narrow brownish to yellow translucent area. Mycelium internal, irregular, adjacent cells frequently of different size, subhyaline to light brownish-yellow, 1–3μ. Conidiophores amphigenous, solitary to loosely tufted, the tufts scattered over the spots, emerging through the stomata or rupturing the epidermis, simple, straight to flexuous, borne on a short, loose to compact stroma, or, especially when solitary, non-stromatic, amber-brown to Brussels brown, 40–285$\times$3–4μ, continuous to distantly 1–6 septate, conidial scars distinct and scattered. Conidia acicular, at times narrowly obclavate to slightly fusiform, hyaline to subhyaline, 55–230$\times$2–2.5$\times$1–1.5μ, continuous to obscurely several septate.

On leaves of *Alternanthera achyrantha* R. Br. and **A. portoricensis* Kuntze. The fungus on *A. portoricensis* differs somewhat from the original description of *C. alternantherae* Ell. & Langl. on *A. achyrantha* in conidiophore and conidial measurements and septation. The original description with respect to these characters is as follows: "hyphae, 25–30$\times$5μ, continuous . . . . ; condia . . . . 1–3 septate, 65–80$\times$3μ." These characters for the fungus on *A. portoricensis* are: conidiophores 40–285 $\times$3–4μ, continuous to 1–6 septate; conidia 55–230$\times$2–2.5μ, continuous to obscurely several septate. A comparison of the two indicates that either

the original description was based on young material or that the two are distinct. The latter contention, however, is not borne out by a comparison of the spots produced, the manner of conidiophore production, nor conidiophore and conidial shape and color. The fungi on the two host species are, therefore, in all probability members of the same species.

Specimens examined: Herb. Univ. of Ill. Porto Rican Fungi, Nos. 3976 and 8479 (Coama, Porto Rico).

Cercospora apii Fresenius, Beitr., 3:91, 1863. Pl. XI, figs. 46–54.—Frank, Krank. d. Pflantzen, p. 603, 1880.—Ellis and Everhart, Jour. Myc. 1: 36, 1885.—Saccardo, Syll. Fung., 4: 442, 1886; Fungi Ital., Pl. 667.—Scribner, Rep. Sec. Agric., U. S., 1886, p. 117. Pl. V.—Atkinson, Cornell Bull., 49: 314, 1892. fig. 5.—Briosi and Cavara, I Funghi Parass., Fasc. XI, No. 268, 1896. figs. 1–3.—Duggar and Bailey, Cornell Bull., 132: 201, 1897. figs. 48–50.—Prillieux, Malad. d. Plant. Agric., 2: 355, 1897. fig. 406.—Hume, Fla. Sta. Rept. 1899 and 1900, p. 34. Pl. II.—Kirchner, Krank. u. Beschäd. unser land. Kulturpfl., 2nd Ed., pp. 296, 355, 1906.—Kirchner and Boltshauser, Atlas III, Pl. 10, figs. 1–2.—Lindau in Rabenhorst's Kryptogamen-Flora, 9: 123, 1910.—Massee, Diseases Cult. Plants, p. 486, 1910. fig. 147.—Schwarze, N. J. Bull., 313: 130, 1917, figs. 780–781.—Stevens, Fungi Which Cause Plant Disease, p. 628, 1921. fig. 426.—Klotz, Mich. Sta. Tech. Bull., 63, 1923. Pls. I–IX.—Stevens, Plant Disease Fungi, p. 414, 1925. fig. 388.

Type locality: Germany (?)

Spots amphigenous, subcircular to somewhat angular, more or less confluent, at times vein-limited, frequently causing contortion of the leaf, 1–10 mm. to 2 cm., at first dark green, becoming yellowish towards the centers, then pale brown to tan, and eventually whitish, not infrequently appearing olivaceous due to the abundance of conidiophores; border indefinite to definite, not raised or slightly raised, olivaceous, about 60μ wide. Mycelium internal, irregular, hyaline, subhyaline, light yellowish-brown to olivaceous, 1.5–3.5μ, 3.5–6.5μ in the stromata. Condiophores amphigenous, solitary to rather densely tufted, rupturing the epidermis or emerging through the stomata, simple or rarely branched, straight to flexuous, with a more or less bulbose base, arising from a stroma formed from loosely to fairly compactly interwoven hyphae, yellowish-brown to olive-brown, 20–125$\times$3–6μ, continuous to 1–2 septate towards bases, conidial scars distinct, aggregated towards the tips or somewhat scattered. Conidia at first more or less cylindrical, then somewhat fusiform, and finally acicular to acicular-obclavate, subhyaline to light yellowish-green, 15–195$\times$2.5–4.5 $\times$1–3μ, continuous to 1–25 closely septate. [Fig. 1.]

On leaves and stems of **Apium graveolens* L. and *A. graveolens* L. var. *rapaceum* DC.

Klotz lists conidiophores up to 180μ and not infrequently having cross walls throughout their whole length. He also lists conidia to 290μ with 29 cross walls.

Considerable variability exists in conidiophore and conidial measurements of several of the specimens examined. Some of these measurements are as follows: conidiophores 25–125×3.3–4.5μ, conidia 20–175×2.5–3.8 ×1.3–2.5μ; conidiophores 20–75×4.5–5.8μ, conidia 28–195×3–4.2×2–3μ; conidiophores 20–80×4–6μ, condia 15–160×3–4×1.5–3μ; conidiophores 20–55×3.5–4.5μ, conidia 20–150×2.5–4×1–2.2μ. The septation of the conidia in these cases varied directly with their length. The above differences may mean that *Cercospora apii* consists of several varieties. It is more probable, however, that the variations are due to external environmental factors than to internal factors, since size alone is the apparent variable.

Specimens examined: v. Thümen, Herb. Myc. Oec., No. 463 (Conegliana, Italy).—Briosi and Cavara, I Funghi Parass., No. 268 (Meaux, France).—Roumeguère, Fungi Sel. Exs., No. 6906 (Meaux, France).—Ellis and Everhart, N. Amer. Fungi, Sec. Ser., No. 1739a (Columbia, Mo.); Fungi Columb., No. 885a (London, Canada).—Seymour and Earle, Ec. Fungi, Nos. 440a (Columbus, Ohio) and 440b (New Brunswick, N. J.).—Bartholomew, Fungi Columb., No. 4004 (St. Paul, Neb.).

Cercospora atrogrisea Ellis and Everhart, Proc. Acad. Nat. Sci. Phila., 1893, p. 464.—Saccardo, Syll. Fung., 11: 625, 1896.

Type locality: Newfield, N. J., Ellis and Everhart, N. Amer. Fungi, Sec. Ser., No. 3089; Fungi Columb., No. 394.

Spots none, the conidia and conidiophores forming gray to slaty-black patches on pods and stems. Conidiophores densely tufted, the tufts closely compacted, seated on a vertically elongated, compact stroma, simple, with a bulbose base, straight to subflexuous, cinnamon brown, 40–110×4–5μ, continuousto 1–6 septate, conidial scars distinct and rather distantly scattered. Conidia acicular, rarely narrowly obclavate, subhyaline, 50–200×3–4×1.5–2μ, 6–18 closely septate.

On dead stems and pods of **Raphanus sativus* L.

Specimens examined: Ellis and Everhart, N. Amer. Fungi, Sec. Ser., No. 3089 (type) (Newfield, N. J.,); Fungi Columb., No. 394 (type) (Newfield, N. J.).

Cercospora davisii Ellis and Everhart, Proc. Acad. Nat. Sci. Phil., p. 89, 1891.—Atkinson, Jour. Elishu Mitch. Sci. Soc., 8: 60, 1891.—Saccardo, Syll. Fung., 10: 622, 1892.—Davis, Trans. Wis. Acad., 21: 275, 1924.

Type locality: Racine, Wisconsin, J. J. Davis, No. 1089. Topo-type: J. J. Davis, Racine, Wis., 1890. Issued in Ellis and Everhart, N. Amer, Fungi, Sec. Ser., No. 2581.

Spots amphigenous, subcircular, more or less vein-limited, at times confluent, 1–5 mm., greenish to dark brown; border indefinite or in part definite, slightly raised, yellowish-brown, 30–75μ wide. Mycelium internal, hyaline, subhyaline to light brownish-yellow, 1.5–4.5μ. Conidiophores amphigenous, loosely to somewhat densely tufted, emerging through the stomata or rupturing the epidermis, simple, straight to subflexuous, with or without a bulbose base, arising from a stroma of loosely to fairly compactly interwoven, irregular hyphae, pale Dresden brown, 20–85$\times$3–6μ, continuous or 1–2 septate above the bases, conidial scars distinct, shouldered mostly aggregated towards the tips. Conidia at first cylindrical, then acicular, subhyline to light greenish-yellow, 20–140$\times$2.2–4.5$\times$1.2–2.5μ, at first continuous, becoming closely 1–13 septate.

On leaves and stems of **Melitotus alba* Desr.

Davis records conidiophores up to 140μ.

Specimens examined: Ellis and Everhart, N. Amer. Fungi, Sec. Ser., No. 2581 (Racine, Wis.).—Bartholomew, Fungi Columb. No. 1811 (Stockton, Kans.).

Cercospora demetrioniana Winter, Hedw., 23: 170, 1884; Rabenhorst-Winter, Fungi Europaei, Ser. II, No. 3079, 1886.—Ellis and Everhart, Jour. Myc., 1: 34, 1885.—Saccardo, Syll. Fung., 4: 439, 1886.

Spots amphigenous, circular, at times confluent, mostly concentrically zoned, rusty-brown to dark-brown above, light-brown to deep olive-brown below, not very definitely limited, 1–1.5 mm. in diameter. Mycelium internal, regular to irregular, mostly fine, subhyaline to greenish-yellow, becoming quite coarse near stromatic areas, the coarser mycelium being yellow to yellowish-brown, 1.5–6μ in diameter. Condiophores amphigenous, solitary to somewhat densely tufted, tufts scattered, rupturing the epidermis or emerging through the stomata, arising from a loose to fairly compact stroma, simple, straight to subflexuous, Brussels-brown, 40–350$\times$4–6μ, 1–10, remotely septate, conidial scars distinct and distantly scattered. Conidia acicular to somewhat fusiform, rarely narrowly obclavate, hyaline to greenish-yellow, 50–210$\times$3.5–5.5$\times$1.5–3μ, 7–16 very closely septate.

On leaves of **Crotalaria sagittalis* L.

The original description lists conidiophores up to 1 mm. in length.

Specimens examined: Rabenhorst-Winter, Fungi Europaei, Ser. II, No. 3079 (type) (Perryville, Mo.).—Ellis and Everhart, N. Amer. Fungi, Sec. Ser., No. 1744 (Faulkland, Del.).

Cerospora echinocystis Ellis and Martin, Am. Nat., 16: 1003, 1882.—Ellis and Everhart, Jour. Myc., 1: 40, 1885.—Saccardo, Syll. Fung., 4: 452, 1886.—Davis, Trans. Wis. Acad., 18: 268, 1916.

Type locality: Lexington, Ky., W. A. Kellerman.

Spots amphigenous, angular, vein-limited, more or less confluent, 0.5–3 mm., light brown, becoming brownish-white to white; border indefinite. Mycelium internal, hyaline, 1.5–6μ, the larger dimensions obtaining just beneath the conidiophores. Conidiophores amphigenous, solitary or loosely tufted, rupturing the epidermis or rarely emerging through the stomata, simple, flexuous, non-stromatic, or rarely with a loose stroma, Dresden brown to Saccardo's umber, 25–200×3.5–6μ, continuous or 1–5 septate, conidial scars distinct, shouldered, scattered. Conidia acicular to to acicular-obclavate, hyaline to light greenish-yellow, 25–200×2–4.5 ×1–3μ, closely, or rather distantly 1–15 septate.

On leaves of **Echinocystis lobata* (Michx.) T. and G. and **Sicyos angulatus* L.

The above description differs considerably from the original in the measurements given. The maximum length for the conidia and especially for the conidiophores of the original description is much below that given above. However, specimens were examined in which the conidiophores varied from the short ones (45μ) recorded by Ellis and Martin and the longer ones recorded above. No other differences were noted. The variability in length is apparently due to differences in age of the specimens when collected.

In the specimen on *Sicyos angulatus*, Seymour and Earle, Ec. Fungi, No. 285, the conidiophores were not infrequently branched. In other specimens on the same host branching was rare. No branching was observed, on the other host species. The branches were for the most part opposite. subtending a terminal conidial scar. In the branched specimens the geniculations were much more pronounced than in the other. No further significant differences were observed.

For the present the two forms are left under *C. echinocystis* Ell. and Mart., although it is quite possible that they are distinct.

Specimens examined: Ellis and Everhart, N. Amer. Fungi, Sec. Ser., No. 1746 (West Chester, Pa.).—Seymour and Earle, Ec. Fungi, No. 285 (New Brunswick, N. J.).—Herb. Univ. Ill. *ex* Herb. Univ. Wis., J. J. Davis, Lynxville, Wis., Sept. 9, 1915; Herb. Univ. Ill. *ex* Crypt. Herb. of F. L. Stevens, New Brunswick, N. J., Aug. 24, 1892.

Cercospora ipomoeae Winter, Rabenhorst-Winter, Fungi Europaei, Ser. II, No. 3585, 1886; Hedw., 26: 34, 1887.—Ellis and Everhart, Jour. Myc., 4: 7, 1888.—Saccardo, Syll. Fung., 10: 633, 1892.—Hennings, Engler's Bot. Jahrb., 34: 605, 1905.—Anderson, U. S. Dept. Ag. Bull., 1366: 54, 1926.

Type locality: Perryville, Mo., Rabenhorst-Winter, Fungi Europaei, Ser. II, No. 3585.

Spots amphigenous, subcircular to angular, somewhat vein-limited, more

or less confluent, 1–4 mm., olivaceous, olive-brown to brown, becoming grayish centered, darker above than below; border definite, raised, blackish-brown, 75–225μ, the whole surrounded by a narrow yellow translucent or purplish opaque area. Mycelium internal, more or less irregularly inflated, hyaline to dilute brownish, 1.5–6μ. Conidiophores amphigenous, loosely tufted, rupturing the epidermis, simple, straight to flexuous, non-stromatic, or approaching a very loose stromatic condition, dilute Brussels brown, 20–325×3–6μ, continuous or 1–7 septate; conidial scars distinct, scattered, more or less shouldered. Conidia acicular, hyaline, 25–330×2.5–3.5 ×1–2μ, somewhat obscurely 1–30 septate.

On leaves of **Ipomoea lacunosa* L., *I. pandurata* G. F. W. Mey, *I. purpurea.* Lam., *I.* (*Pharbitis*) *hederacea* Jacq.

In Roumeguère, Fungi Sel. Exs., No. 4487, the host is recorded as *I. laciniosa* L. This, no doubt, should be *I. lacunosa* L., since the former name does not appear in any of the standard indexes.

Specimens examined: Rabenhorst-Winter, Fungi Europaei, Ser. II. No. 3585 (type) (Perryville, Mo.).—Roumeguère, Fungi Sel. Exs., No. 4487 (Concordia, Mo.).

Cercospora lippiae Ellis and Everhart, Jour. Myc., 3: 20, 1887.—Saccardo, Syll. Fung., 10: 632, 1892.—Davis, Trans. Wis. Acad., 14: 96, 1903.

Type locality: Louisiana, Langlois, No. 826.

Spot amphigenous, circular, rarely confluent, brown, dark-brown to grayish-brown above, light-brown , olive-brown to grayish-brown below, 1–3 mm. in diameter; border definite, raised, brown to dark-brown, at times reddish-brown, 150-300μ, the whole not infrequently surrounded by a narrow brown to red discolored area. Mycelium internal, almost regular to irregular, hyaline to light yellowish-brown, 1.5–4.5μ. Conidiophores amphigenous, densely tufted, emerging through the stomata, simple, straight to subflexuous, arising from a short compact stroma, pale yellowish-brown to olive-brown, 20–55×2.5–4.5μ, continuous to 1–2 septate, conidial scars minute but distinct, somewhat warty and closely aggregated. Conidia narrowly obclavate to somewhat fusiform, rarely acicular, subhyaline to light greenish-yellow, 25–350×2–3×1–2μ, closely 3–16 septate.

On leaves of **Lippia nodiflora* Michx. and **L. lanceolata* Michx.

Specimens examined: Ellis and Everhart, N. Amer. Fungi, Sec. Ser., No. 3088 (Port Byron, Ill.); Fungi Columb., No. 387 (Port Byron, Ill.)—Bartholomew, Fungi Columb., Nos. 2213 (Belvue, Kans.) and 3005 (Stillings, Mo.).

Cercospora angulata Winter, Hedw., 24: 202, 1885. On *Philadelphus coronarius* L., Rabenhorst-Winter, Fungi Europaei, Ser. II. No. 3588 (type) (Perryville, Mo.).

Cercospora arctii Stevens, Bull. Bernice P. Bishop Mus., 19: 154, 1925.

On *Arctium lappa* L., Herb. Univ. of Ill., Hawaiian Fungi, No. 1096 (Kukuikaele, Hawaii).

Cercospora beticola Saccardo, Fungi Ven., Ser. V, p. 189. 1878. On *Beta vulgaris* L. Various miscellaneous specimens of the Herb. Univ. of Ill.

Cercospora canescens Ellis and Martin, Am. Nat., 16: 1003, 1882. On *Phaseolus lunatus* L., Rabenhorst-Winter, Fungi Europaei, Ser. II, No. 3788 (Perryville, Mo.).

Crecospora clavata (Gerard) Peck, 34 Rept. N. Y. State Mus., p. 48, 1881. On *Asclepias incarnata* L., Herb. Univ. of Ill., No. 32961 *ex* Herb. U. S. Dept. Agric., Div. V. P. P., No. 1131 (Urmeyville, Ind.).

Cercospora cruenta Saccardo, Mich., 2: 140, 1880. On *Phaseolus* sp., Ellis and Everhart, N. Amer. Fungi, Sec. Ser., No. 2294 (Locality not given),

Cercospora depazeoides (Desmazieres) Saccardo, Novo Goirn. Bot. Ital. 8: 187, 1876. On *Sambucus nigra* L., Ellis and Everhart, N. Amer. Fungi, Sec. Ser., No. 1749b (Ames, Ia.).

Cercospora malvarum Saccardo, Mich., 2: 365, 1880. On *Malva rotundifolia* L., Ellis and Everhart, Fungi Columb., No. 884. (Newfield, N. J.).

Cercospora microsora Saccardo, Mich., 2: 128, 1880. On *Tilia europaea* L., Briosi and Cavara, I Funghi Parass., No. 44 (Italy).

Cercospora oculata Ellis and Kellerman, Bull. Torr. Bot. Club, 11: 116, 1884. On *Vernonia baldwinii* Torr., Ellis and Everhart, Fungi Columb., No. 598 (Rockport, Kan.).

Cercospora physalidis Ellis, Am. Nat., 16: 810, 1882. On *Physalis virginiana* Mill., Ellis and Everhart, Fungi Columb., No. 1085 (Rooks Co., Kan.).

Cercospora radiata Fuckel, Symb. Myc., p. 354, 1869. On *Trigonella foenumgraceum* L., Thümen, Myc. Univ., No. 584 (Vigheffio, Parma, Italy).

Cercospora resedae Fuckel, Symb. Myc., p. 353, 1869. On *Reseda odorata* L., Briosi and Cavara, I Funghi Parass., No. 83 (Pavia, Italy).

Cercospora sagittariae Ellis and Kellerman, Jour. Myc., 2: 1, 1886. On *Sagittaria latifolia* Willd., Ellis and Everhart, Fungi Columb., No. 693 (West Townshend, Vt.). [Fig. 7.]

Cercospora squalidula Peck, 33 Rept. N. Y. State Mus., p. 29, 1880. On *Clematis virginiana* L., Rabenhorst-Winter, Fungi Europaei, Ser. II, No. 3288 (Decorah, Ia.).

Cercospora teucrii Ellis and Kellerman, Bull. Torr. Bot. Club, 11: 116, 1884. On *Teucrium canadense* L., Ellis and Everhart, Fungi Columb., No. 459 (Rockport, Kan.).

Cercospora violae-tricoloris Briosi and Cavara, I Funghi Parass., No. 185. On *Viola tricolor* L., (type) (Pavia, Italy).

SECTION V

Mycelium internal, conidiophores simple, stroma composed of loosely to fairly compactly interwoven hyphae, or rarely none produced, conidia abruptly obclavate.

Cercospora magnoliae Ellis and Harkness, Bull. Tor. Bot. Club, 8: 27, 1881.—Ellis and Everhart, Jour. Myc., 1: 35, 1885.—Saccardo, Syll Fung., 4: 459, 1886.—Schwarze, N. J. Bull., 313: 136, 1917, figs. 814–815.

Type locality: Newfield, N. J., Ellis and Harkness, Nov. 1880, Ellis, N. Amer. Fungi, No. 643.

Spots amphigenous, subcircular, more or less vein-limited, minute, 0.3–0.6 mm., dark-brown above, becoming white centered, purplish below; border definite above, raised, dark-brown to brown, 90–150 μ; below indistinct and not much different from the main spot. Mycelium internal, hyaline to yellowish, 0.5–3 μ, stromatic mycelium brownish-yellow. Conidiophores hypophyllous, densely tufted, rupturing the epidermis, simple, straight to subflexuous, arising from a small stroma, Dresden brown to olive-brown, 25-275$\times$2-3 μ, continuous or several septate, conidial scars more or less indistinct, somewhat warty. Conidia obclavate, straight or curved, more or less constricted at septa, apical cell beak-like, olivaceous, 25–42$\times$5–6$\times$2.5-3.5 μ, 1-3-6 septate.

On leaves of **Magnolia glauca* L.

Specimens examined: Ellis, N. Amer. Fungi, No. 643 (type) (Newfield, N. J.).—Rabenhorst-Winter, Fungi Europaei, Ser. II, No. 3286 (Newfield, N. J.).

Cercospora petroselini Saccardo, Ann. Myc., 10: 321, 1912; Syll. Fung., 22: 1423, 1913.—Ellis and Everhart, Jour. Myc., 1: 37, 1885, sub *Cercospora apii* Fresenius.

Syn. *Cercospora apii* Fresenius var. *petroselini* Saccardo, Syll. Fung., 4: 442, 1886.—Lindau in Rabenhorst's Kryptogamen-Flora, 9: 124, 1910.

Type locality:?

Spots amphigenous, subcircular to circular, more or less vein-limited, 0.5–1.5 mm., greenish to yellowish-brown, appearing olivaceous to black due to abundance of conidiophores; border indefinite. Mycelium internal, irregular, hyaline to light yellowish-brown, 2.2–6μ, stromatic mycelium Dresden brown to olive-brown, 6–10 μ, the cells of the latter being almost isodimatric. Conidiophores amphigenous, very densely tufted, rupturing the epidermis or emerging through the stomata, inflated upon emerging

from the host, simple, flexuous, distorted, arising from a stroma of closely compacted hyphae, Dresden brown to olive-brown, very dilute towards the tips, 35–85×5–7 μ, continuous or 1 septate near the bases; conidial scars distinct, scattered, somewhat warty. Conidia obclavate to cylindrical, hyaline to light greenish-yellow, 15–40×3.5–6×3–3.5 μ, 1 septate.

On leaves of **Petroselinum hortense* Hoffm.

Ellis and Everhart describe the conidia as being 1–3 septate and 30–50×5–7 μ. Saccardo records them as 1–2 septate and 36–40×4–5 μ. In the specimens listed below no conidia were found with more than 1 septum.

Specimens examined: Thümen, Myc. Univ., No. 483 (Parma, Italy); Herb. Myc. Oec., No. 464 (Parma, Italy).

Cercospora superflua Ellis and Holway, Jour. Myc., 2: 2, 1886.—Saccardo, Syll. Fung., 4: 471, 1886.

Type locality: Decorah, Iowa, E. W. D. Holway, Aug. 1885, Ellis and Everhart, N. Amer. Fungi, Sec. Ser., No. 1525.

Spots amphigenous, subcircular to irregular, more or less vein-limited, 2–7 mm., light brown; border definite, very slightly raised, a little darker brown than the spot, 50–100 μ. Mycelium internal, hyaline, 1.5–4.5 μ, stromatic mycelium 3–7.5 μ. Conidiophores amphigenous, moderately to somewhat densely tufted, the tufts thickly scattered over the spots, rupturing the epidermis, simple, straight or almost so, arising from a loose to compact stroma, olive-brown to Dresden brown, 10–30×4–5 μ, continuous, conidial scars fairly distinct. Conidia obclavate, curved, Dresden brown, 20–75×5–7.5×2–3 μ, 2–6–7 septate.

On leaves of **Fraxinus* sp. (?)

Specimens examined: Ellis and Everhart, N. Amer. Fungi, Sec. Ser., No. 1525 (type) (Decorah, Iowa).

Cercospora bolleana (Thümen) Spegazzini, Mich., 1: 475, 1879. On *Ficus carica* L., Briosi and Cavara, I Funghi Parass., No. 85 (Pavia, Italy).

Cercospora cerasella Saccardo, Mich., 1: 266, 1879. On *Prunus virginiana* L., Bartholomew, Fungi Columb., No. 1608 (Rooks Co., Kan.)

Cercospora desmodii Ellis and Kellerman, Bull. Torr. Bot. Club, 11: 121, 1884. On *Desmodium* sp., Ellis and Everhart, N. Amer. Fungi, Sec. Ser., No. 1501 (Manhattan, Kan.).

Cercospora rosaecola Passerini, in Thümen's Myc. Univ., No. 333, 1876. On *Rosa blanda* Ait., Bartholomew, Fungi Columb., No. 3412 (London, Ontario, Canada).

Cercospora simulata Ellis and Everhart, 1: 64, 1885. On *Cassia marilandica* L., Ellis and Everhart, N. Amer. Fungi, Sec. Ser., No. 1751 (Granville, Mass.).

Cercospora umbrata Ellis and Holway, Jour. Myc., 2: 2, 1886. On *Bidens* sp., Ellis and Everhart, N. Amer. Fungi, Sec. Ser., No. 1521 (type) (Decorah, Ia.).

SECTION VI

Mycelium internal, conidiophores simple, stroma composed of loosely to fairly compactly interwoven hyphae, or rarely none produced, conidia cylindrical or somewhat fusiform.

Cercospora cana Saccardo, Myc. Ven., No. 593, 1876; Nuovo Giorn. Bot. Ital., 8: 188, 1876.—Rábenhorst, Fungi Europaei, No. 2153, 1876; Hedw., 15: 119, 1876.—Saccardo, Fungi Ital., Pl. 68, 1877; Mich., 1: 88, 1877.—Frank, Krankh. d. Pfl., pp. 593–601, 1880. Figs. 107, 108, 110.—Ellis and Everhart, Jour. Myc., 1: 54, 1885.

Syn. *Cercosporella cana* (Saccardo) Saccardo, Mich., 2: 364, 1881; Syll. Fung., 4: 218, 1886.—Costantin, Les Mucédinées Simples, p. 74, 1888. Fig. 36^{2-3}.—Davis, Trans. Wis. Acad., 11: 166, 1898.—Kellerman, Jour. Myc., 9:172, 1903; Ohio Fungi., No. 142, 1906.—Lindau in Rabenhorst's Kryptogamen-Flora, 8: 429, 1907. Fig. 2.—Davis, Trans. Wis. Acad., 16: 742, 1910; 17: 889, 1914; 21:257, 1924.

Fusidium canum Passerini, in Thümen, Myc. Univ., No. 378, 1876.

Type locality: Selva, Italy, P. A. Saccardo, Aug. 1875, Myc. Ven., No. 593, Rabenhorst, Fungi Europaei, No. 2153.

Spots amphigenous, mostly definite, rarely indefinite, subcircular to somewhat angular, more or less vein-limited, at times confluent, 1–6 mm., light green at first, becoming light yellowish-green, light brown to dark brown, darker above than below, frequently appearing grayish to grayish-white, especially on the lower surface, due to the abundance of conidiophores and conidia, margin at times greenish; border indefinite. Mycelium internal, subhyaline, rarely light Dresden brown, 1.5–4.5 μ, stromatic mycelium subhyaline to light to dark Dresden brown, 2.5–9 μ. Conidiophores amphigenous, or in some cases hypophyllous, moderately tufted, emerging through the stomata, simple, or very rarely branched, straight below, substraight to prominently geniculate in region of conidial production, arising from a loose to compact stroma, subhyaline to light greenish-yellow, 20–106×3–6 μ, continuous or 1–3 septate, conidial scars distinct, prominently denticulate, closely aggregated towards the tips, or more rarely somewhat scattered. Conidia oblong-cylindrical to narrowly obclavate, straight or somewhat curved, subhyaline to light greenish-yellow, 25–100–140×3.5–6.5×2.5–4 μ, continuous or 1–5–9 somewhat distantly septate.

On leaves of **Erigeron* sp., **E. canadensis* L., **E. annuus* (L.) Pers.,

E. philadelphicus L., *E. ramosus* (Walt.) BSP., **Solidago* sp., and *S. canadensis* L.

The position of the conidiophores on the upper and lower surfaces of the leaves is correlated with the particular host species. On *E. canadensis* they are abundant on both surfaces, on *E. annuus* they are mostly hypophyllous, and on the species of Erigeron in Ellis' N. Amer. Fungi, No. 1248, they are present only on the lower surface. On Solidago they are abundant on both surfaces of the leaves.

The fungus on Solidago, Herb. Univ. of Ill. *ex* Coll. Mo. State Univ., No. 20219, differed from the forms on Erigeron in that the conidial scars were scattered in the former and aggregated towards the tips in the latter. This difference is quite possibly due to different growth conditions and since the various specimens agreed in all other respects it is perhaps not of any significance.

It is impossible to say with absolute certainty whether Passerini or Saccardo first named this species. The first publication in a journal was by Saccardo, Nuovo Giorn. Bot. Ital., April 30, 1876. However, this publication was antedated by Passerini as Saccardo calls attention to *Fusidium canum* Pass. in a note to his species. The date of publication, therefore, depends on whether Saccardo's Myc. Ven. Cent. VI was issued before Thümen's Myc. Univ. Cent. VI. Both were issued early in 1876, apparently before April 30. Since Saccardo retains his name calling attention to Passerini's it is perhaps right to assume that Myc. Ven. Cent VI was issued the earlier of the two exsiccati. Lindau (l. c.) has apparently adopted this view, giving Saccardo credit for the species.

Specimens examined: As *Cercospora cana* Sacc., Rabenhorst, Fungi Europaei, No. 2153 (type) (Selva, Treviso, Italy).—Rabenhorst-Winter, Fungi Europaei, Ser. II, No. 3290 (Amanda, Ohio).—Ellis, N. Amer. Fungi, No. 1248 (Amanda, Ohio).—Herb. Univ. of Ill. *ex* Coll. Mo. State Univ., No. 20219 (Columbia, Mo.). As *Cercosporella cana* (Sacc.) Sacc., Sydow, Myc. Ger., No. 1171 (Brandenburg).—Ellis and Everhart, Fungi Columb., No. 595 (Port Byron, Ill.).—Seymour and Earle, Ec. Fungi, Nos. 310 (Middlebush, N. J.) and 312 (New Brunswick, N. J.).—Kellerman, Ohio Fungi, No. 142 (Buckeye Lake, Ohio).—Bartholomew, Fungi Columb., Nos. 2918 (London, Canada) and 4009 (Ithaca, N. Y.). As *Fusidium canum* Pass., Thümen, Myc. Univ., No. 378 (type) (Parma, Italy).

Cercospora carotae (Passerini) Solheim n. sp.

Syn. *Cercospora apii* Fresenius var. *carotae* Passerini, Mem. R. Acad. Linnei, Roma, IV ser., 6: 469, 1890.—Saccardo, Syll. Fung., 10: 624, 1892.—v. Höhnel, Ann. Myc., 1: 530, 1903.—Lindau in Rabenhorst's Kryptogamen-Flora, 9: 125, 1910.

Type locality: Parma, Italy.

Spots amphigenous and caulicolus, subcircular on the leaves, oblong-elliptical on the stems, more or less vein-limited and confluent, 0.3–3 mm. on the leaves, 1–4×1 mm. on the stems, light brown to dark brown, usually lighter in color towards the centers of the spots than at edges; border definite, more or less raised, dark purplish-brown, 45–150 μ, the whole at times surrounded by a very narrow yellow translucent area. Mycelium internal, hyaline, 1.5–6μ, the larger hyphae obtaining beneath the conidiophores. Conidiophores amphigenous, solitary or loosely tufted, emerging through the stomata or rupturing the epidermis, simple, straight to subflexuous, with or without a bulbose or inflated base, non-stromatic, light yellowish-brown, 15–45×3–5μ, continuous; conidial scars minute, rather indistinct, mostly aggregated towards the tips. Conidia at first cylindrical, then narrowly-obclavate, bacilliform, hyaline to subhyaline, 30–115×2–3×1.5μ, continuous or obscurely 1–8 septate.

On leaves and stems of **Daucus carota* L.

The original description calls for conidiophores hyaline, septulate; conidia 30–65×3.5–4μ. The conidiophores of the specimens examined were not hyaline but the color was very dilute. It is quite probable that they are hyaline when young. Just what is meant by septulate is difficult to say. Since no septa were observed it may be taken to mean that there was some doubt as to whether or not septa were actually present.

This fungus is distinctly different from *C. apii* Fresen. The conidia are much shorter and narrower. The septa are indistinct and the distance between them is about twice that in the conidia of *C. apii* Fresen. The conidiophores are equally distinct.

Specimens examined: Sydow, Myc. Ger., No. 1043 (Brandenburg).—Ellis and Everhart, N. Amer. Fungi, Sec. Ser., Nos. 2482a (Emma, Mo.) and 2482b (New Brunswick, N. J.).—Seymour and Earle, Ec. Fungi, No. 442 (New Brunswick, N. J.).

Cercospora pastinacae (Saccardo) Peck, Bull. N. Y. State Mus., 157: 45, 107, 1912.—Ellis and Everhart, Jour. Myc., 1: 37, 1885, sub *Cercospora apii*.

Syn. *Cercospora apii* Fresenius var. *pastinacae* Saccardo, Syll. Fung., 4: 442, 1886.

Type locality: ?

Spots amphigenous, inconspicuous, sub-angular to irregular, vein-limited, at times confluent, 0.5–2 mm., yellowish-green, rusty-brown to tan above, olivaceous to light yellowish-brown below; border indefinite. Mycelium internal, irregular, hyaline to subhyaline, 1.5–4.5μ, stromatic mycelium dilute yellowish-brown, 4.5–7μ. Conidiophores amphigenous, loosely to somewhat densely tufted, the tufts being uniformly scattered over the spots, emerging through the stomata, simple, flexuous, inflated

as they emerge from the host, arising from a stroma of loosely to somewhat compactly interwoven hyphae, light olive-brown to yellowish-brown 15–76×4–7μ, continuous, or 1 septate near bases; conidial scars distinct, scattered, warty. Conidia acicular, fusiform, straight or curved, light greenish-yellow, 30–95×4–5.5×2–3μ, continuous to distantly 1–3 septate. [Fig. 14.]

On leaves of **Pastinaca sativa* L.

Peck lists the conidia as being 25–85×6–8μ which is slightly different from the above measurements.

Ellis and Everhart referred this fungus to *C. apii* Fresen. but stated that it was perhaps specifically distinct. Later Saccardo gave it the name of *C. apii* Fresen. var. *pastinacae* Sacc. Peck examining the fungus in 1912 concluded that it was a distinct species. His conclusion is undoubtedly correct. The spots produced, the conidiophores and conidia, of this fungus differ markedly from those of *C. apii* Fresen.

Specimens examined: Ellis and Everhart, N. Amer. Fungi, Sec. Ser., No. 1739b (Columbia, Mo.).—Seymour and Earle, Ec. Fungi, No. 443 (New Brunswick, N. J.).—Thümen, Herb. Myc. Oec., No. 321 (Bayreuth, Bavaria). On the last specimen two kinds of spots were present, one of which appeared to be due to *C. pastinacae* (Sacc.) Peck. However, no fruiting bodies could be found.

Cercospora pastinacina Solheim n. name and n. comb.

Syn. *Cercosporella pastinacae* Karsten, Hedw., 23: 63, 1884.—Saccardo, Syll. Fung., 4: 219, 1886. Kirchner, Krank. u. Beschäd. unserer Land. Kulturpflanzen, p. 396, 1906.—Lindau, in Rabenhorst's Kryptogamen-Flora, 8: 424, 1907.—Cotton, Kew Bull. Misc. Inf., 1918, p. 19, fig. 2.

Type locality: Mustiala, Finland.

Spots amphigenous, subcircular, more or less confluent, 0.5–3 mm., at first brown, then becoming white centered; border definite, slightly raised, brown, 50–200μ. Mycelium internal, hyaline to subhyaline, 1.5–4.5μ, individual cells frequently irregular in outline. Conidiophores amphigenous, indistinct, densely tufted, scattered in vein-limited sectors of the spots, rupturing the epidermis, simple, straight to subfluexuous, tapering, arising from a short compact stroma, subhyaline to very dilute yellowish, 14–30 ×2–3μ, continuous; conidial scars fairly distinct, aggregated at tips. Conidia narrowly-obclavate, bacilliform, subhyaline to dilute yellowish, 20–110×1–2.5×0.8–1.5μ, obscurely 1–6 septate.

On leaves of **Pastinaca sativa* L.

No cross walls were observed in the conidiophores. From the nature of the material it was, however, impossible to determine whether or not they never are present.

This fungus has been confused with *C. pastinacae* (Sacc.) Peck. The

reason for this is apparently due to a misconception of what the latter actually is since the two are quite distinct.

Since the genus Cercospora already contains a valid species bearing the name *C. pastinacae* (Sacc.) Peck, it is necessary to secure a new name for the above discribed fungus. *C. pastinacina* Solheim is the name given it.

Specimens examined: As *C. apii* Fresen., Ellis and Everhart, Fungi Columb., No. 885b (London, Canada). As *C. apii* Fresen. var. *pastinacae sativae*, Thümen, Myc. Univ., No. 1169 (Bayreuth, Bavaria).

Cercospora campi-silii Spegazzini, Mich., 2: 171, 1880.—Saccardo, Syll. Fung., 4: 440, 1886.—Lindau in Rabenhorst's Kryptogamen-Flora, 9: 115, 1910. Ann. Myc., 25: 286, 1927.

Type locality: Consiglio, Italy.

Spots amphigenous, angular to subcircular, more or less vein-limited, at times confluent, 1–5 mm; smaller spots grayish-green above, larger spots tri-colored, with a grayish-green center surrounded by a tan-colored zone which in turn is surrounded by a darker brown border above, similar below but somewhat brownish throughout; border indefinite or definite, slightly raised, brown, 50–350μ. Mycelium internal, fairly regular, subhyaline, 1.6–3.2–4.9μ, in diameter. Conidiophores amphigenous but mostly hypophyllous, solitary or loosely to somewhat densely tufted, emerging through the stomata or rupturing the epidermis, simple, or rarely with opposite branches, erect, subflexuous to flexuous, non-stromatic, dilute olivaceous, 30–100–140$\times$3.2–6.5μ, continuous or somewhat obscurely 1, rarely 2, septate; conidial scars distinct, mostly shouldered, at times denticulate, scattered. Conidia cylindrical to fusiform, subhyaline to dilute olivaceous, 15–50$\times$2–3.5$\times$1.6–3.5μ, up to 6.5μ at the widest point, 1–6 somewhat irregularly septate.

On leaves of **Impatiens nolitangere* L.

One conidium was observed germinating and producing a conidiophore.

The conidiophores of specimen No. 2034, Sydow, Myc. Ger., were not infrequently branched. The branching, however, was not uniformly distributed but confined to certain sectors on the spots. The conidiophores of the other specimens listed were not branched.

Specimens examined: Sydow, Myc. Ger., No. 2034 (Schröpfurth, Brandenburg). Krypt. Exs., No. 2040 (Tullnerbach, Austria).

Cercospora dubia (Riess) Winter, Hedw., 22: 10, 1883. On *Chenopodium album* L., Bartholomew, Fungi Columb., No. 4211 (Ithaca, N. Y.).

Cercospora granuliformis Ellis and Holway, Jour. Myc., 1: 6, 1885. On *Viola cucullata* Ait., Ellis and Everhart, Fungi Columb., No. 445 (Nuttallburg, W. Va.).

Cercospora maianthemi Fuckel, Symb. Myc., p. 353, 1869. On *Maianthemum convallaria* Web., Rabenhorst-Winter, Fungi Europari, Ser. II, No. 3590a (Borussia near Halle, Germany).

Cercospora osmorrhizae Ellis and Everhart, Proc. Nat. Acad. Sci. Phil., p. 89, 1891. On *Osmorrhiza longistylis* (Torr.) DC., Ellis and Everhart, Fungi Columb., No. 458 (Racine, Wis.).

Cercospora toxicodendri Ellis, Am. Nat., 16: 811, 1882. On *Rhus toxicondendron* L., Ellis and Everhart, N. Amer. Fungi, Sec. Ser., No. 1524 (Newfield, N. J.).

Section VII

Mycelium internal, conidiophores with opposite branching, stroma composed of loosely to fairly compactly interwoven hyphae, or rarely none produced, conidia abruptly obclavate.

Cercospora cercidicola Ellis, Am. Nat., 16: 810, 1882; Jour. Myc., 1: 36, 1885.—Saccardo, Syll. Fung., 4: 463, 1886.—Atkinson, Jour. Elishu Mitch. Sci. Soc., 8: 42, 1891.—Halsted, N. J. Agr. Exp. Sta. Rept., 1896, p. 397, figs. 45–47.—Schwarze, N. J. Bull., 313: 132, 1917, figs. 789–791.—Anderson U. S. Dept. Agr. Bull., 1366: 33, 1926.

Syn. *Cercospora cercidicola* Ellis var. *coremioides* Tehon, Myc., 16: 140, 1924. Pl. 13, fig. 11.

Type locality: Lexington, Ky., W. A. Kellerman, 1882, Ellis N. Amer. Fungi, No. 1246.

Spots amphigenous, circular to angular, vein-limited, 1–4 mm., blackish-brown to rusty-brown becoming grayish above but remaining rusty-brown beneath; border definite, raised, black to black-brown, 75–150μ, the whole surrounded by a reddish or brown to rusty-brown zone. Mycelium internal, hyaline to subhyaline, 1–4.5μ, stromatic mycelium olive-brown, 3–7μ. Conidiophores amphigenous but mostly hypophyllous, coremioid, loosely to rather densely tufted, emerging through the stomata or rupturing the epidermis, straight for about one-half to three-fourths their length, very flexuous throughout remainder of their length, arising from a small stroma of compactly interwoven hyphae, olive-brown, 50–280$\times$3–5μ, 1–8 septate, more or less branched, branches mostly opposite and subtending a terminal conidial scar, rarely monopodially branched below the region of conidial production and then subtending a septum, conidial scars distinct, prominently denticulate, collected towards tips. Conidia obclavate, straight or curved, olivaceous, 20–55$\times$4–6.5$\times$2–3μ, distinctly 1–3 septate. [Fig. 5.]

On leaves of **Cercis canadensis* L., *C. japonica Sieb.*, and *C. occidentalis* Torr.

The coremioid character on which *C. cercidicola* Ell. var. *coremioides* Tehon is based is characteristic of the species.

This fungus appears to be closely related to *C. petersii* (B. and C.) Atk., having the same habit of growth and the same type of conidia and conidiophores.

Specimens examined: Ellis, N. Amer. Fungi, No. 1246 (type) (Lexington Ky.).—Bartholomew, Fungi Columb., No. 3306. (Cabin John Bridge, Md.).

Section VIII

Mycelium internal, conidiophores with alternate branching, stroma tuberculate, conidia acicular-obclavate.

Cercospora heucherae Ellis and Martin, Am. Nat., 18: 189, 1884.—Ellis and Everhart, Jour. Myc., 1: 34, 1885.—Saccardo, Syll. Fung., 4: 453, 1886.—Davis, Trans. Wis. Acad., 9: 166, 1893.

Type locality: Chester Co., Pa., Ellis, N. Amer. Fungi, No. 1258.

Spots amphigenous, circular, convex above, concave below, scattered over the leaf, 1.5–5 mm.; uniformly brown to dark-brown or with a tan-colored center, at times with a reddish tint above, similar below but lighter and somewhat olive-tinted; border definite surrounding the tan center when present as well as the major spot, dark-brown, very narrow, 15–25μ, the whole surrounded by a yellowish, at times red-tinted, halo, 30–90μ to 1 mm. Mycelium internal, somewhat regular to very irregular, much branched, hyaline to olive-brown, more or less guttulate, 1.5–4.6μ in diameter. Conidiophores amphigenous, densely tufted, the tufts somewhat scattered over the spots, rupturing the epidermis or emerging through the stomata, intricately branched towards the bases, branching penicillioid, the whole forming a compact tubercle-like structure capped by the ultimate branches (25–50$\times$3.5–4.5μ) which superficially appear to be the complete conidiophores, somewhat flexuous, geniculate, yellowish-brown to olive-brown, 35–100$\times$3.5–5μ, closely septate in tuberculate region, continuous to 1–2 septate in superficial region. Conidia narrowly obclavate, rarely acicular, hyaline to light greenish-yellow, 10–115$\times$2.5–3.5$\times$1.5–2.5μ, 2–14 septate.

On leaves of **Heuchera americana* L. and *Heuchera sp.*

Germinated conidia were observed on the spots. Germ tubes emerged at the base and tip and also at the sides. The tubes traversed the epidermis until they came to stomata through which they made entrance into the host.

The branching of the conidophores of this species is very distinct. It much resembles that of Penicillium from which it differs in that it is at the basal end of the conidiophore. Superficial examination does not reveal the branching but gives the impression that the fungus is an ordinary unbranched Cercospora with a stroma. The tubercle-like formation produced by the compact conidiophores indicates that the true Cercospora

tubercle is perhaps formed from the basal portion of the conidiophores instead of the mycelium.

Specimens examined: Ellis, N. Amer. Fungi, No. 1258 (type) (Chester Co., Pa.).—Herb. Univ. of Ill. *ex* Herb. F. L. Stevens, Ohio Fungi, Nos. 40 (Marblehead, L. Erie) and 181 (Sciota River, O.).

Cercospora rhoina Cooke and Ellis, Grev., 6: 89, 1878.—Ellis and Everhart, Jour. Myc., 1: 33, 1885.—Saccardo, Syll. Fung., 4: 467, 1886.—Atkinson, Jour. Eli. Mitch. Sci. Soc., 8: 47, 1891.—Carver, Proc. Ia. Acad., 8: 165, 1900.—Schwarze, N. J. Bull., 313: 140, 1917. figs. 832–836.

Syn. *Cercospora copallina* Cooke, Grev., 12: 31, 1883.—Saccardo, Syll. Fung., 4: 468, 1886.

Type locality: New Jersey. Kew No. 2656.

Spots amphigenous, suborbicular to irregular, more or less vein-limited, tan-colored, dark-brown, blackish-brown, purplish-brown or reddish-brown above, light-brown to dark-brown, or reddish-brown below, in age sometimes becoming greyish, border indefinite or definite and dark brown to purplish, somewhat raised, the surrounding leaf tissue usually with a reddish discoloration. Mycelium internal, 2.5–4μ in diameter, much branched, subhyaline to light yellowish brown, the darker color obtaining especially beneath the tufts of tuberculate conidiophores. Conidiophores amphigenous, densely tufted, emerging through the stomata or rupturing the epidermis, tuberculate, somewhat branched at or near the bases, rarely above, straight to subflexuous, geniculate, olive-brown, 20-100×3–4μ, septate towards the bases. Conidia oblong-cylindrical to narrowly fusoid or obclavate-acicular, more or less curved, subhyaline to light olive-yellow, 30–160×3–4×1.6–3.0μ, obscurely 3–14 septate.

On leaves of **Rhus glabra* L., **R. copallina* L., **R. typhina* L., *R. pumila* Michx., *R. toxicodendron* L., *R. vernix* L., *R. canadensis* Marsh. and *R.* sp.

The branching and septation of the conidiophores are a little difficult to observe due to the dense tufts. Sections as well as masseration after boiling, however, bring these points out very clearly. In the specimens examined the longest conidiophores noted were 100μ. Atkinson records them up to 150μ.

The specimen recorded as *C. rhoina* Cooke and Ellis, on *Rhus aromatica*, Sydow, Fungi Exot. Exs., No. 447, is immature. Although the spots resemble those produced by this fungus, it can not definitely be said that the causal organism is *C. rhoina* Cooke and Ellis. Roumeguère, Fungi Sel. Exs., No. 4387, recorded as *C. rhoina* Cooke and Ellis, is mislabeled. Beyond this the material did not permit of further determination.

Only one specimen of the fungus on *Rhus typhina*, Herb. Univ. of Ill., No. 32982, *ex* Herb. U. S. Dept. of Agric., Div. of V. P. P., No. 1815, has been seen. This specimen lacked conidia. The spots, mycelium, and coni-

diophores were all typical of *C. rhoina* and the determination is in all probability correct.

In comparing the type collection of *C. copallina* Cooke in Ravenel, Fungi Amer. Exs., No. 586, as well as other collections with various collections of *C. rhoina* Cooke and Ellis, the difference between the two as inferred by Cooke was not observed. Both have the same types of spots, mycelium, olive-brown tuberculate conidiophores, and obscurely septate, obclavate-acicular conidia. Ellis and Everhart, Jour. Myc., 1: 34, 1885, could find no difference between the two. *C. copallina* Cooke must, therefore, be considered a synonym of *C. rhoina* Cooke and Ellis.

Specimens examined: As *C. rhoina* Cooke and Ellis, Ellis, N. Amer. Fungi, No. 47 (Newfield, N. J.); No. 1252 (Manhattan, Kan.).—Ellis and Everhart, Fungi Columb., No. 794 (Newfield, N. J.).—Bartholomew, Fungi Columb., No. 2613 (Lincoln, Neb.); No. 2809 (Rogers, Ark.); No. 4613 (Tallahassee, Fla.).—Roumeguère, Fungi Gallici Exs. No. 3876 (Manhattan, Kan.).—Seymour and Earle, Ec. Fungi, No. 119 (Granville, Mass.).—Herb. Univ. of Ill. *ex* Herb. Univ. of Wis., specimen collected by J. J. Davis at Lynxville, Wis., Aug. 31, 1915; Herb. Univ. of Ill., No. 32982 *ex* Herb. U. S. Dept. of Agric., Div. of V. P. P., No. 1815. (Washington, D. C.). As *C. copallina* Cooke, Ravenel, Fungi Amer. Exs., No 586 (Aiken, S. C.).—Ellis and Everhart, N. Amer. Fungi, Sec. Ser., No. 1505 (Green Cove Springs, Fla.).—Rabenhorst and Winter, Fungi Europaei, Ser. II, No. 3682 (Green Cove Springs, Fla.).—Herb. Univ. of Ill. *ex* Herb. A. B. Seymour, specimen collected by G. Martin at Green Cove Springs, Fla., Dec. 1884.

Cercospora ribicola Ellis and Everhart, Proc. Acad. Sci. Phil., p. 379, 1894. On *Ribes sanguineum* Pursh., Ellis and Everhart, N. Amer. Fungi, Sec. Ser., No. 3391 (Seattle, Wash.).

Section IX

Mycelium internal, conidiophores with alternate branching, stroma tuberculate, conidia cylindrical.

Cercospora smilacis Thümen, Instituto de Coimbra, 27: 24, 1879; Hedw., 19: 135, 1880; Myc. Univ., Nos. 1670 and 1768, 1880.—Saccardo, Syll. Fung., 4: 476, 1886.—Overholts, Ann. Mo. Bot. Gard., 14: 428, 1927. Pl. 40.

Type locality: Coimbra, Portugal, Thümen, Myc. Univ., No. 1768; prototype, Myc. Univ., No. 1670.

Spots amphigenous, circular to angular, more or less vein-limited, at times confluent, 0.5–5 mm., dark-brown, somewhat darker above than below; border definite, raised, dark-brown to blackish-brown on inner margin, light to dark brown on outer margin, 75–200μ. Mycelium internal, very

irregular, hyaline to olive-brown, 2–7.5μ, forming here and there compact stromatic mats, stromatic mycelium dark olive-brown, 4.5–10μ. Condiophores amphigenous but mostly hypophyllous, densely tufted, rupturing the epidermis, with a bulbose base, flexuous, arising from a large, compact, tuberculate stroma, Brussels brown 25–140×4.5–6μ, 1–5 septate, somewhat branched, branches well developed each producing several conidia, conidial scars more or less obscure, somewhat warty, scattered. Conidia oblong-clyndrical to narrowly obclavate, olivaceous, 20–125×3–4.5×2–4.5μ, continuous or 1–10 septate. [Fig. 9.]

On leaves of **Similax mauritanica* L.

Overholts lists conidiophores up to 225μ and conidia to 135μ.

The conidia germinate in two ways, either they produce an infecting mycelium or they produce conidiophores directly.

This species differs from *C. petersii* (B. and C.) Atk. in having branched, erect, but not coremioid conidiophores and much narrower conidia.

C. simlacis Thüm., Ellis, N. Amer. Fungi, No. 1251, does not belong under this species. It does not appear to agree with any of the described species of Cercospora on *Smilax*. However, until further studies can be made of these species it is advisable to leave it as now designated.

Specimens examined: Thümen, Myc. Univ., Nos. 1670 (prototype) and Tyype) (Coimbra, Portugal).—Rabenhorst-Winter, Fungi Europaei, Ser. II, No. 2975 (Coimbra, Portugal).—Roumeguère, Fungi Sel. Exs., No. 5189 (Coimbra, Portugal).

Section X

Mycelium internal, conidiophores with alternate branching, stroma composed of loosely to fairly compactly interwoven hyphae, or rarely none produced, conidia cylindrical.

Cercospora consociata Winter, Hedw.,22: 70, 1883.—Ellis and Everhart, Jour. Myc., 1: 53, 1885.—Saccardo, Syll. Fung., 4: 470, 1886.

Type locality: Illinois, A. B. Seymour.

Spots amphigenous, angular, vein-limited, 4–10 mm., more or less sunken below and correspondingly raised above, dark grayish-brown to smoky-brown; border indefinite, or in part definite, not raised or slightly raised, blackish-brown, 0.0–500μ. Mycelium internal, more or less verrucose, hyaline to very dilute olivaceous, 1.5–3.5μ, stromatic mycelium olive-brown, 2.5–6μ. Conidiophores amphigenous, loosely to moderately tufted, emerging through the stomata, underlate with a more or less bulbose base, arising from a loose to somewhat compact stroma, light oliqe-brown, 20–55×3–4.5μ, 1–4 septate, conidial scars indistinct, scattered, branched monopodially at or near the base, less frequently above, two or more branches may develop on a single conidiophore, branches well de-

veloped, producing several conidia. Conidia oblong-cylindrical to bacilliform, very slightly thickened below, greenish-yellow, 35–130×2–3.5×1.5–2μ, 2–8 septate.

On leaves of **Ruellia ciliosa* Pursh.

The above description differs from the original in recording the conidiophores as being amphigenous. The original description states that they are hypophyllous.

Specimens examined: Ellis and Everhart, N. Amer. Fungi, Sec. Ser., No. 2477 (Emma, Mo.).

Cercospora lateritia Ellis and Halsted, Jour. Myc., 4: 7, 1888. On *Sambucus racemosa* L., Ellis and Everhart, N. Amer. Fungi, Sec. Ser., No. 1994. (type) (Ames, Ia.).

Cercospora lupini Cooke, Hedw., 17: 39, 1878. On *Lupinus diffusus* Nutt., Ravenel, Fungi Amer. Exs., No. 67 (Aiken, S. Car.).

Section XI

Mycelium internal, conidiophores with alternate and opposite branching, stroma composed of loosely to fairly compactly interwoven hyphae, or rarely non-produced, conidia cylindrical.

Cercospora illinoensis Bartholomew, Fungi Columb., No. 2611, 1908.—Saccardo, Syll. Fung., 22: 1428, 1913.

Type locality: Farmington, Ill., E. Bartholomew, No. 3696, Sept. 18, 1907

Spots indefinite, conidiophores effused in velvety, olive-brown to Brussels brown patches below, the leaf tissue above the patches becoming yellowish to brown and dotted with scattered tufts of conidiophores, the latter being especially grouped along the veins. Mycelium internal, hyaline, subhyaline to Dresden brown, 1–4.5–6μ, stromatic mycelium up to 7.5μ. Conidiophores amphigenous, loosely to moderately tufted below, rather densely tufted above, emerging through the stomata below, rupturing the epidermis above, straight to subflexuous, more or less geniculate, arising from a loose to somewhat compact stroma, Brussels brown, 30–265×3–4.5μ, at times up to 6μ towards tips, 2–25 septate, branched, the branches irregularly alternate, or opposite and subtended by a terminal conidial scar, well developed, conidial scars distinct, laterally displaced and warty or shouldered, aggregated towards the tips. Conidia oblong-cylindrical, tapering slightly, straight or somewhat curved, light yellowish-olive, Dresden brown to Prout's brown, 25–115×3.5–6×2.5–5μ. 1–10–13 septate. [Fig. 8.]

On leaves of **Asclepias syriaca* L.

Specimens examined: As *Cercospora illinoensis* Barth., Bartholomew, Fungi Columb., No. 2611 (type) (Farmington, Ill.).—Specimen collected

at Urbana, Ill., Sept. 9, 1927 (culture study). As *Cercospora clavata* (Ger.) Peck, Bartholomew, Fungi Columb., No. 4006 (Ithaca, N. Y.).—Farlow, Reliquiae Farlowianae, No. 161 (Newton, Mass.).

Cercospora fusco-virens Saccardo, Mich., 2: 149, 1880. On *Passiflora lutea* L., Rabenhorst-Winter, Fungi Europaei, Ser. II, No. 3586 (Perryville Mo.).

Section XII

Mycelium internal and external, conidiophores simple, stroma tuberculate, conidia acicular-obclavate.

Cercospora helianthemi Briosi and Carvara, I Funghi Parass., No. 334,1900. figs. 1–3.—Traverso, Malpighia, 14: 478, 1900.—Lindau in Rabenhorst's Kryptogamen-Flora, 9: 120,1910.—Saccardo, Syll. Fung., 22: 1414, 1913.

Type locality: Pavia, Italy, Briosi and Cavara, I Funghi Parass., No. 334.

Spots amphigenous, circular, more or less confluent, greatly hypertrophied, 0.5–2 mm., brown above, becoming grayish centered, below olivaceous; border definite but distinguishable only in section, raised. Mycelium external and internal; external mycelium regular to irregular, the cells frequently of irregular outline, hyaline to light olivaceous, 1.5–7.5μ; internal mycelium very irregular, hyaline to light olivaceous to yellowish-brown, 1.5–5μ, stromatic mycelium 4.5–6μ. Condiophores amphigenous, moderately to densely tufted, emerging through the stomata, more rarely rupturing the epidermis, or sparsely scattered on the external mycelium, straight to subflexuous, or somewhat flexuous towards the tips, arising from a compact tuberculate stroma, Brussels brown, 25–215×4–6.5μ, continuous or 1–5 septate, somewhat branched, the branches of monopodial origin, more or less scalariform, conidial scars distinct, scattered or somewhat aggregated at various points on the conidiophores, more or less shouldered. Conidia acicular, hyaline, 25–160×2.5–4×1.5–2μ, closely 1–18 septate.

On leaves of *Helianthemum* sp. and **H. polifolium* DC. var. *roseum* Wk.

The external mycelium of this fungus is rather difficult to see. Only with the use of the oil immersion lens is it clearly brought out. The branched conidiophores may also quite readily be overlooked.

Specimens examined: Briosi and Cavara, I Funghi Parass., No. 334 (type) (Pavia, Italy).

Cercospora ilicis Ellis, Bull. Torr. Bot. Club, 8: 65, 1881. On *Ilex glabra* (L.) Gray, Ellis, N. Amer. Fungi, No. 548 (type). (No locality given.)

Section XIII

Mycelium internal and external, conidiophores simple, stroma tuberculate, conidia abruptly obclavate.

Cercospora condensata Ellis and Kellerman, Jour. Myc., 1: 2, 1885; Hedw., 24: 127, 1885.—Ellis and Everhart, Jour. Myc., 2: 2, 1886.—Saccardo, Syll. Fung., 4: 438, 1886.—Davis, Trans. Wis. Acad., 18: 267, 1916.

Type locality: Manhattan, Kans., W. A. Kellerman, July 1884. Prototype, Manhattan, Kans., W. A. Kellerman, Sept. 1884, Ellis and Everhart, N. Amer. Fungi, Sec. Ser., No. 1518.

Spots amphigenous, irregular, vein-limited, 0.5–1.5 mm., dark brown to brown, becoming whitish centered; border definite, raised, dark brown, 100–200μ. Mycelium external and internal; external mycelium arising from the internal and emerging through the stomata, olivaceous, 3–6μ, somewhat irregularly constricted at septa; internal mycelium hyaline to yellowish, very fine, 1–3μ; stromatic mycelium olive-brown to blackish-brown, 3–7.5μ. Conidiophores amphigenous, densely tufted below, much more so above, emerging through the stomata, rupturing the epidermis, or scattered on the external mycelium, simple, straight to subflexuous, arising from a large tuberculate stroma, olive-brown, 30–70$\times$4–6μ, continuous, or 1–2 septate, conidial scars minute, distinct, subdentate, aggregated towards the tips. Conidia obclavate to narrowly obclavate, straight or somewhat curved, olive-brown, 40–160$\times$3–6$\times$2–3μ, 6–15 septate, at times slightly constricted at septa.

On leaves of **Gleditschia triacanthos* L.

In the specimen distributed in Seymour and Earle, Ec. Fungi, No. 121, the conidiophores had apparently had two distinct periods of growth. The portion developed in the second period was practically hyaline as compared with the fairly deep olive-brown portion previously produced.

Specimens examined: Ellis and Everhart, N. Amer. Fungi, Sec. Ser., No. 1518 (prototype) (Manhattan Kans.).—Seymour and Earle, Ec. Fungi, No 121 (Havana, Ill.).

Cercospora petersii (Berkeley and Curtis) Atkinson, Jour. Elishu Mitch. Sci. Soc., 8: 57, 1891; Ala. Bull., 80: 149, 1897. Sub *Cercospora smilacis* Thümen, Peck, 33 Rept. N. Y. State Mus., p. 29, 1880. Pl. 2, figs. 1–3. —Ellis and Everhart, Jour. Myc., 1: 33, 1885.—Davis, Trans. Wis. Acad., 21: 274, 1924. Sub *Cercospora smilacina* Sacc., Overholts, Ann. Mo. Bot. Gard., 14: 429, 1927. Pl. 41.

Syn. *Helminthosporium petersii* Berkeley and Curtis, Grev., 3: 102, 1874.—Saccardo, Syll. Fung., 4: 421, 1886.

Type locality: Carolina, Berkley, N. Amer. Fungi, No. 626.

Spots amphigenous, circular to somewhat angular, more or less vein-limited, at times confluent, 0.5–4 mm., reddish-brown, purplish-brown to blackish-brown; border definite, raised, dark reddish-brown to blackish-brown on inner margin, light brown to fairly dark brown on outer margin, 150–325μ, leaf tissue surrounding spot generally discolored. Mycelium internal and external; external mycelium verrucose, olivaceous to olive-brown, 1.5–4.5μ; internal mycelium very irregular, cells irregularly inflated, hyaline, olivaceous, to olive-brown, 1.5–9μ; stromatic mycelium Dresden brown to olive-brown, 3–12μ. Conidiophores amphigenous but mostly hypophyllous, coremioid, moderately to somewhat densely tufted, rupturing the epidermis, or very sparsely scattered on the external mycelium, simple, with a bulbose base, straight for about two-thirds their length, distal one-third divergent and profusely subflexuous to flexuous, arising from a somewhat loose to compact tuberculate stroma, argus brown, Dresden brown, Prout's brown to blackish-brown, 50–230×3–6μ, 1–8 septate, conidial scars small, fairly distinct, somewhat warty, aggregated towards tips. Conidia obclavate, with a more or less bulbose tip, olive-brown, 25–90×4–6×1.5–3.5μ, continuous or 1–7–11 septate, closely septate towards bases, distantly septate towards tips. [Fig. 11.]

On leaves of **Smilax glauca* Walt., **S. rotundifolia* L., **S. sps*, *S. hispida* Muhl., S. *tamnoides* Gray, *S. laurifolia* L., and *Benzoin aestivale* (L.) Nees.

Atkinson lists conidiophores to 300μ and conidia to 100μ.

The conidia were germinating abundantly on all the specimens examined. Germination was mostly from the basal cell although quite common from the other cells as well. Conidia were frequently observed anastomosing. At times the conidia germinated producing short hyphae which in turn produced conidia.

This fungus has commonly been confused with *C. smilacis* Thüm. and *C. smilacina* Sacc. This confusion is undoubtedly due to Peck's misinterpretation of *C. smilacis* Thüm. and his description and drawings based on this wrong conception. The two fungi are quite distinct. (See *C. smilacis* Thüm., l. c.), Saccardo has placed Peck's fungus under the species *C. smilacina* Sacc. It is also distinct from the latter species (l. c.).

Specimens examined: As *Helminthosporium petersii* B. and C., Ravenel, Fungi Amer. Exs., Nos. 166 and 616 (Aiken, S. Car.). As *Cercospora smilacis* Thüm., Ellis and Everhart, Fungi Columb., No. 390 (Newfield, N. J.).—Herb. Univ. of Ill., No. 33002, *ex* Herb. U. S. Dept. Agric., No. 616 (Kanawaha Falls, W. Va.). As *C. smilacina* Sacc., Seymour and Earle, Ec. Fungi, No. 199 (Big Stone Gap, Va.).—Herb. Univ. of Ill., A. B. Seymour, Plainville, Ct. Aug. 27, 1883. As *C. mississippiensis* Tracy and Earle, Bartholomew, Fungi Columb., No. 2808 (Batesville, Ark.).

Cercospora gymnocladii Ellis and Kellerman, Bull. Torr. Bot. Club, 11: 121, 1884. On *Gymnocladus dioica* (L.) Koch, Bartholomew, Fungi Columb., No. 2212 (Grand Island, Neb.). [Fig. 4.]

Section XIV

Mycelium internal and external, conidiophores simple, stroma tuberculate, conidia cylindrical.

Cercospora acrocomiae Stevenson, Rep. Ins. Exp. Sta., Porto Rico, 7: 89, 1917.

Type locality: Rio Piedras, Porto Rico, July 1914, No. 2090; Feb. 1912, (Johnston) No. 4206; July 1917, No. 6604 (type).

Spots amphigenous, few, areas between spots dying out so as to make large, continuous, dead areas, circular to elliptical, 5–20 mm. long by 3–6 mm. broad, rarely wider, at first reddish-brown, then tricolored, a central circular to elliptical gray area, 2–6×0.5–3 mm., enclosed by a blackish-brown band 2–3 mm. wide, with an outer more or less irregular reddish-brown to brown area, often not completely encircling the central portions; border indefinite. Mycelium external and internal; external mycelium arising from the internal and emerging through the stomata, irregular, olive-brown, 1.5–6μ; internal mycelium irregular, somewhat verrucose, olive-brown, darker than the external and mostly coarser, 2–9μ; stromatic mycelium dark Dresden brown to olive-brown, 2–9μ. Conidiophores amphigenous but mostly hypophyllous, confined to the central gray areas of the spots, densely tufted, rupturing the epidermis, simple, straight to subflexuous, irregularly inflated or constricted, arising from a large tuberculate stroma, Argus brown, enlarged towards the tips, i.e., tapering from tips towards bases, 30–160×3–5μ, up to 7.5μ at tips, 2–9 septate, conidial scars indistinct. Conidia oblong cylindrical, straight, curved or doubly curved, Brussels brown to Prout's brown, 40–130×6–12×6–12μ, 4–12 closely septate.

On leaves of **Acrocomia media* Cook.

Specimens examined: Herb. Univ. of Ill., No. 4206a, collected by John R. Johnston, Rio Piedras. Porto Rico, Feb, 14, 1912.

Cercospora silphii Ellis and Everhart, Jour. Myc., 4: 3, 1888. On *Silphium integrefolium* Michx., Ellis and Everhart, Fungi Columb., No 456 (Rockfort, Kan.).

Section XV

Mycelium internal and external, conidiophores simple, stroma composed of loosely to fairly compactly interwoven hyphae, or rarely none produced, conidia acicular-obclavate.

Cercospora sorghi Ellis and Everhart, Jour. Myc., 3: 15, 1887.—Saccardo, Syll. Fung., 10: 656, 1892.—Carver, Proc. Ia. Acad., 8: 165, 1900.

Type locality: Plaquemines Co., La., Aug. 1886. Langlois, No. 543.

Leaves at first stained dark purple, in strips of several inches in extent, the affected part becoming dead and dry, the centers of the strips becoming grayish brown, the edges remaining purple. Mycelium internal and external; external mycelium very regular, subhyaline, 1.0–2.0μ; internal mycelium very irregular, the adjacent cells frequently varying considerably in size and shape, subhyaline to light brown, 1–6.5μ Conidiophores amphigenous, loosely tufted, emerging through the stomata or very rarely arising from the external mycelium, simple, straight or becoming subflexuous towards the tips, arising from a compact stroma, Dresden brown, 35–145$\times$3.2–5.0μ, 1–4 septate, conidial scars distinct, more or less shouldered, mostly grouped on the upper half of the conidiophore. Conidia acicular or somewhat cylindrical when young, subhyaline, 45–240$\times$2–3.2$\times$1–1.5μ, somewhat obscurely 5–20 septate.

On leaves of **Sorghum halapense* (L.) Pers., *S. vulgare* Pers., and *Zea mays* L.

Specimens examined: Ellis and Everhart, N. Amer. Fungi, Sec. Ser., No. 1768 (Point a la Hache, La.).

Cercospora rubi Saccardo, Nuovo Giorn. Bot. Ital., 8: 188, 1876. On *Rubus trivialis* Michx., Ellis and Everhart, N. Amer. Fungi, Sec. Ser., No. 1740 (St. Gabial, La.).

Section XVI

Mycelium internal and external, conidiophores simple, stroma composed of loosely to fairly compactly interwoven hyphae, or rarely none produced, conidia abruptly obclavate.

Cercospora ampelopsidis Peck, Rept. N. Y. State Mus., 30: 55, 1878.—Ellis and Everhart, Jour. Myc., 1: 55, 1885.—Saccardo, Syll. Fung., 4: 459, 1886.—Davis, Trans. Wis. Acad., 21: 289, 1924.

Syn. *Cercospora pustula* Cooke, Grev., 12: 30, 1883. Saccardo, Syll. Fung., 4: 458, 1886.

Type locality: Bethlehem, N. Y., C. H. Peck, July.

Spots amphigenous, circular to angular, more or less vein-limited, 1–8 mm., at first blackish to reddish-black, becoming reddish-brown to brown above, below brown, raw umber, Saccardo's umber to olive-brown; border indefinite or definite, at times definite above and indefinite below, raised, black to brownish-black above, dark brown below, 0.2–1 mm., the whole frequently surrounded by a reddish discolored area. Mycelium internal and external; external mycelium regular to irregular, subhyaline to dilute raw umber, arising from the internal and emerging with the tufts of

conidiophores, 0.8–3–4.5μ; internal mycelium hyaline, olivaceous to dilute raw umber, occasionally producing groups of beaded cells, 1.5–4.5–6μ; stromatic mycelium olive-brown, Dresden brown to raw umber, 3.5–7.5μ. Conidiophores amphigenous, loosely to moderately tufted, emerging through the stomata or rupturing the epidermis, simple, or rarely irregularly branched, straight to flexuous, at times somewhat undulate, with a more or less bulbose base, arising from a loose to compact stroma, Brussels brown, Prout's brown, raw umber to olive-brown, 35–215×3–6μ, 2–10 septate, conidial scars laterally displaced and somewhat warty to denticulate, or at times shouldered. Conidia at first cylindrical, then abruptly obclavate, straight or somewhat curved, olivaceous, light Dresden brown to raw umber, 20–115×3–5–6.5×1.5–3μ, 1–7–15 septate, distinctly septate towards bases, somewhat obscurely septate towards tips.

On leaves of **Parthenocissus* sp., *P. quinquefolia* Planch., *P. quinquefolia* Planch. var. *hirsuta* Planch.

The specimen distributed in Roumeguère, Fungi Sel. Exs., No. 5589, had no fruiting fungus on it. The spots present did not in any respect resemble those described above.

Specimens examined: As *Cercospora ampelopsidis* Peck, Rabenhorst-Winter, Fungi Europaei, Ser. II, No. 3291 (Bethlehem, Pa.).—Seymour and Earle, Ec. Fungi, No. 7 (Urbana, Ill.).—Ellis and Everhart, N. Amer. Fungi, Sec. Ser., No. 1748 (West Chester, Pa.).—Bartholomew, Fungi Columb., No. 3506 (London, Canada).—Specimen collected at White Heath, Ill., July 23, 1927 (culture study). As *Cercospora pustula* Cooke, Ravenel, Fungi Amer. Exs., No. 779 (type) (Darien, Ga.).—Ellis and Everhart, N. Amer. Fungi, Sec. Ser., No. 2474 (St. Martinsville, La.).

Cercospora olivacea (Berkeley and Ravenel) Ellis, Jour. Myc., 1: 52, 1885. On *Gleditschia triacanthos* L., Rabenhorst-Winter, Fungi Europaei, Ser. II, No. 2974 (Fulton Co., Ill.).

Cercospora thalictri Thümen, Cont. Fl. Mycol. Lusit., p. 5, 1878. On *Thalictrum flavum* L., Thümen, Myc. univ., No. 1470 (type) (Coimbra, Portugal).

Section XVII

Mycelium internal and external, conidiophores with alternate branching, stroma tuberculate, conidia abruptly obclavate.

Cercospora glomerata Harkness, Bull. Calif. Acad. Sci., 3: 164, 1885.—Kellerman, Jour. Myc., 1: 106, 1885.—Saccardo, Syll. Fung., 4: 472, 1886.

Type locality: Tamalpais, Calif., H. W. Harkness, March, 1884,

No. 3651. Prototype, H. W. Harkness, Tamalpais, Calif., March, 1884, Ellis and Everhart, N. Amer. Fungi, Sec. Ser., No. 1641.

Spots amphigenous, angular, spreading from the margin of the leaf inward or originating on the main portion of blade, 1–17 mm., brown, becoming grayish-brown, the lower surface dotted with black punctiform tufts of conidiophores; border definite, slightly raised, tan colored, or brown of a darker shade than that of the main spot. Mycelium external and internal; external mycelium hyaline to Prout's brown, the colored portion more or less verrucose, 1.5–6μ; internal mycelium subhyaline, yellowish-green to Prout's brown, 1.5–4.5μ; stromatic mycelium Prout's brown, 2–6μ. Conidiophores hypophyllous, very rarely epiphyllous, more or less confined to vein-limited sectors of the spots, densely tufted, emerging through the stomata and later rupturing the surrounding epidermis, subflexuous to flexuous, arising from a large structure the lower part of which is composed of a tuberculate stroma above which is a long broad body made up of somewhat loosely interwoven, much branched, more or less parallel hyphae, Prout's brown to Brussels brown, 25–90$\times$3–5.5μ, 2–8 closely septate towards bases, monopodially branched, the branches irregularly placed but mostly near the bases, at times short and again long and well developed, producing several conidia, conidial scars more or less indistinct, laterally displaced or rarely shouldered, slightly warty. Conidia obclavate, abruptly attenuated but only slightly so, apical cell rounded, Dresden brown, 25–77$\times$4.5–7.5$\times$3–4.5μ, 1–5–7 septate, more or less constricted at septa.

On leaves of **Garrya elliptica* Dougl.

The original description gives the diameter of the conidia as 10–12μ. In the specimens examined, both collected at the type locality, no conidia were observed as thick as this.

Specimens examined: Ellis and Everhart, N. Amer. Fungi, Sec. Ser., No. 1641 (prototype) (Tamalpais, Calif.).—Rabenhorst-Winter, Fungi Europaei, Ser. II, No. 3792 (Tamalpais, Calif.).

Section XVIII

Mycelium internal and external, conidiophores with alternate branching, stroma composed of loosely to fairly compactly interwoven hyphae, or rarely none produced, conidia acicular-obclavate.

Cercospora sordida Saccardo, Mich., 2: 149, 1880; Fungi Ital., Pl. 683, 1881; Syll. Fung., 4: 470, 1886.—Ellis and Everhart, Jour. Myc., 1: 53, 1885.—Atkinson, Jour. Elishu Mitch. Sci. Soc., 8: 63, 1891.

Type locality: Georgia, Ravenel.

Spots more or less indefinite, the tufts of conidiophores forming olive-brown, vein-limited patches, or covering the whole of the lower surface of

the leaf, the upper leaf surface above the patches of conidiophores becoming first dark green, then yellowish. Mycelium internal and external; the external mycelium regular, subhyaline to olivaceous, arising from the conidiophores, or from the internal mycelium and emerging with the tufts of conidiophores, 1.5–3 rarely 4.5μ; internal mycelium hyaline, subhyaline, olivaceous or yellowish-olive, 1.5–4.5–6μ, at times forming dark olive-brown tuberculate structures near the upper leaf surface. Conidiophores hypophyllous, emerging through the stomata, or effused on the external mycelium, loosely tufted, straight, subflexuous or flexuous, non-stromatic or arising from a very small stroma, Dresden brown to yellowish-olive, 15–110×3–5μ, at times somewhat enlarged towards the tips, up to 4.5–7.5μ, continuous or 1–5 irregularly septate, at times somewhat constricted, irregularly branched, the branches usually well developed, conidial scars indistinct, rarely shouldered. Conidia oblong-cylindrical to narrowly obclavate, greenish-yellow, olivaceous to Dresden brown, 20–190×3–4.5×2–3.5μ, 2–15 fairly distinctly septate, at times slightly constricted at septa.

On leaves of *Tecoma radicans* (L.) Juss.

Numerous conidia were observed germinating. The germ tube was sent out from any point on the conidium but if a conidium was placed over or just to the side of a stoma it always arose from the point closest to the stoma. Occasionally conidia were observed to germinate and produce conidiophores directly.

Cercospora duplicata Ellis and Everhart, Jour. Myc., 5: 70, 1889, has not been seen. It is quite probable, however, that it is the epiphyllous expression of the above described fungus.

Specimens examined: Ellis, N. Amer. Fungi, No. 1247 (Newfield, N. J.).—Bartholomew, Fungi Columb., Nos. 2315 (Louisville, Kan.), 2812 (Batesville, Ark.), 4212 (Shreveport, La.), and 4514 (Spiro, Okla.).—Rabenhorst-Winter, Fungi Europaei, Ser. II, No. 3794 (Perryville, Mo.).—Seymour and Earle, Ec. Fungi, No. 146 (Starkville, Miss.).

Cercospora acerina Hartig, Lehrb. d. Baumkrankh., p. 113, 1882. On *Acer pseudoplatanus* Falk., Briosi and Cavara, I Funghi Parass., No. 296 (Vallombrosa, Italy).

Cercospora lini Ellis and Everhart, Jour. Myc., 3: 16, 1887. On *Linum virginianum* L., Ellis and Everhart, N. Amer. Fungi, Sec. Ser., No. 1762 (Faulkland, Del.).

Section XIX

Mycelium internal and external, conidiophores with alternate branching, stroma composed of loosely to fairly compactly interwoven hyphae, or rarely none produced, conidia abruptly obclavate.

Cercospora ferruginea Fuckel, in Fresenius, Beitr., 3: 93, 1863; Hedw., 2: 134, 1863; 3: 20, 1864; Symb. Myc., 1: 354, 1869; 2: 20, 1873.—Frank, Krankh. d. Pfl., p. 601, 1880.—Saccardo, Fungi Ital., Pl. 655, 1881; Syll. Fung., 4: 444, 1886.—Grove, Jour. Bot., 24: 204,1886.—Keissler, Ann. Myc., 5: 233,1907.—Lindau in Rabenhorst's Kryptogamen-Flora, 9: 139,1910.

Syn. *Helminthosporium absinthium* Peck, 30 Rept. N. Y. State Mus., p. 54, 1878. pl. 2, figs. 28–30.

Cercospora absinthii (Peck) Saccardo, Syll. Fung., 4: 444, 1886.—Davis, Trans. Wis. Acad., 18: 269, 1916.

Type locality: Rhineland, Fuckel.

Spots indefinite, the conidiophores forming effused brown patches on the lower surface of the leaf, the upper leaf surface above the patches becoming somewhat yellowish. Mycelium internal and external; external mycelium arising from the internal and emerging through the stomata, fine; internal mycelium fine. Conidiophores hypophyllous, rarely epiphyllous, loosely to moderately tufted, emerging through the stomata, or effused on the external mycelium, flexuous, brown, 60–400×4–6μ, at times somewhat swollen towards the tips, 1 to several septate, monopodially branched, branches well developed, conidial scars fairly distinct, laterally displaced, aggregated towards the tips. Conidia abruptly obclavate, very variable in size, especially in thickness, yellowish, 21–102×4–10μ, 1–3–6 septate. [Fig. 6.]

On leaves of **Artemisia vulgaris* L., **A. absinthium* L., *A. japonica* Thumb., *A. ludoviciana* Nutt., *A. suksdorfii* Piper, and *A. vulgaris* L. var. *"indica."*

The conidia of this species are quite variable in size, especially in thickness. Measurements of the conidia of various specimens are as follows: 24–102×5–7μ, 26–100×5–7μ, 25–88×4–6μ, 21–67×6–8μ, 28–75×5–9μ, 28–78×7–10μ. Keissler reports a specimen with conidia 35–40×10–15μ.

The fungus described as *Helminthosporium absinthium* by Peck and later referred to Cercospora by Saccardo, on *Artemisia absinthium*, is undoubtedly the same as *Cercospora ferruginea* Fckl. Peck's species appears to have been based on young material. A comparison of several specimens of the two revealed no differences. *C. absinthii* (Peck) Sacc., therefore, becomes a synonym of *C. ferrunginea* Fckl.

The fungi referred to this species on *Teucrium*, *Erigeron*, and *Ambrosia* do not belong here. They are quite distinct and do not appear to even be closely related.

Specimens examined: As *Cercospora ferruginea* Fckl., Rabenhorst, Fungi Europaei, Nos. 766 (Hostrichia), 1286 (Brünn, Moravia), and 2152

(Selva, Treviso, Italy).—Sydow, Myc. Ger., Nos. 1195 (Lohringen, Germany) and 1775 (Brandenburg, Germany).—Thümen, Myc. Univ., No. 286 (Selva, Treviso, Italy). *Cercospora absinthii* (Pk.) Sacc., Ellis and Everhart, N. Amer. Fungi, Sec. Ser., No. 1770 (Newfield, N. J.); Fungi Columb., No. 1363 (London, Canada).

Cercospora concors (Caspary) Saccardo, Syll. Fung., 4: 449, 1886. On *Solanum tuberosum* L., Rabenhorst-Winter, Fungi Europaei, Ser. II, No. 3790 (Königstein, Germany).

Cercospora menispermi Ellis and Holway, Jour. Myc., 4: 6, 1888. On *Menispermum canadense* L., Ellis and Everhart, Fungi Columb., No. 596 (Nuttallburg, W. Va.).

Cercospora passaloroides Winter, Hedw., 22: 71, 1883. On *Amorpha canescens* Pursh, Ellis and Everhart, N. Amer. Fungi, Sec. Ser., No. 1999 (Manhattan, Kan.).

Section XX

Mycelium internal and external, conidiophores with alternate branching, stroma composed of loosely to fairly compactly interwoven hyphae, or rarely none produced, conidia cylindrical.

Cercospora portoricensis Earle, Muhlenbergia, 1: 16, 1901.—Saccardo, Syll. Fung., 18: 609, 1906.—Stevens, Trans. Ill. State Acad., 10: 212, 1917.

Syn. *Cercospora piperis* Ellis and Everhart, 9th Ann. Rept. Mo. Bot. Gard, p. 119, 1898. Not Patouillard.

Cercospora pipericola Saccardo and Sydow, Syll. Fung., 16: 1073, 1902.

Type locality: *Cercospora portoricensis* Earle, Mayaguez, Porto Rico, Herb. New York Bot. Gard., No. 4359, A. A. Heller. *Cercospora piperis* Ellis and Everhart, Port Morant, Jamaica, Herb. Mo. Bot. Gard., No. 22343, A. S. Hitchcock.

Spots amphigenous, irregular, oblong, or subcircular, vein-limited, more or less confluent, 1–7 mm., greenish, olive-brown, rusty-brown, dark-brown or grayish-black above, similar below but appearing olivaceous due to abundance of conidiophores; border indefinite. Mycelium internal and external; external mycelium regular, fine, 1.5–3μ, subhyaline to light olivaceous, arising from the internal mycelium and emerging through the stomata, or arising from the conidiophores; internal mycelium irregular, 1.5–6μ, hyaline, subhyaline to light olivaceous. Conidiophores hypophyl-

lous, at times amphigenous, loosely to somewhat densely tufted, emerging through the stomata or scattered on the external mycelium, straight to subflexuous, spreading, non-stromatic or loosely stromatic, Dresden brown to olivaceous to fairly dark olive-brown, 15–125×3–5μ, continuous or irregularly 1-6 septate, not infrequently with adjacent cells of unequal diameter, branched, the branches arising from any point on the conidiophore, mostly at right angles and, when more than one, all on the same side; conidial scars indistinct. Conidia oblong-cylindrical to narrowly-obclavate, light brownish-yellow to olivaceous, 25–120×2.5–4–5×2–3.5μ, at first continuous, later somewhat irregularly 1–10 septate, guttulate. [Fig. 13.]

On leaves of *Piper* sps., **P. aduncum* Auct., **P. hispidum* Sw., **P. peltatum* L., and **P. umbellatum* L.

Epiphyllous conidiophores were rare and observed only on *P. hispidum* and *P. peltatum*.

The type materials of *C. portoricensis* Earle and *C. piperis* Ell. and Ev. have been examined and compared. No essential difference exists between the two. The slight differences that do exist, such as shades of color, size of conidia and conidiophores, appear to be due to differences in age in the specimens. *C. piperis* Ell. and Ev. is based on very young material, while *C. portoricensis* Earle is based on old material. Both specimens show the same type of external and internal mycelium; they have conidia and conidiophores structurally alike and branched in the same manner. *C. piperis* Ell. and Ev. must, therefore, drop into synonomy. *C. portoricensis* Earle becomes the name of the fungus, since *C. piperis* Pat. antedates *C. piperis* Ell. and Ev., thus invalidating the latter name.

Specimens examined: As *C. piperis* Ell. and Ev., Herb. Mo. Bot. Gard., No. 22343 (type) (Port Morant, Jamaica) (Courtesy of Mo. Bot. Gard.). As *C. portoricensis* Earle, Herb. N. Y. Bot. Gard. No. 4359 (type) (Mayaguez, Porto Rico) (Courtesy of N. Y. Bot. Gard.).—Herb. Univ. of Ill., J. A. Stevenson, Nos. 3315 (Bayamon, Porto Rico) and 2867 (Rio Piedras, Porto Rico); Herb. Univ. of Ill., Porto Rican Fungi, Nos. 7035 (Mayaguez), 9131 (Juana Diaz), 146 (Caoma) and 7133 (Porto Rico).

Cercospora agerati Stevens, Bull. Bernice P. Bishop Mus., 19: 154, 1925. On *Ageratum conyzoides* L., Herb. Univ. of Ill., Hawaiian Fungi, No. 944 (Kealakakua).

Cercospora amorphophalli Hennings, Hedw., 41: 147, 1902. On *Amorphophallus campanulatus* Blume., Herb. Univ. of Ill., specimen collected by M. B. Raimundo, Nov. 1, 1913, Los Bunos, Philippine Islands.

Section XXI

Mycelium internal and external, conidiophores with alternate and opposite branching, stroma composed of loosely to fairly compactly interwoven hyphae, or rarely none produced, conidia cylindrical.

Cercospora lobeliaecola Solheim, n. name. On *Lobelia cardinalis* L., Ellis and Everhart, N. Amer. Fungi, Sec. Ser., No. 1516 (Manhattan, Kan.).

This fungus has been known as *C. effusa* (B. & C.) Ell. [= Cladosporium effusum B. & C.]. The specific name given by Berkeley and Curtis rightly belongs to the fungus on *Polygonum punctatum* described by these authors. This fungus has been known as *Cercospora hydropiperis* (Thüm.) Speg. It is now referred to Didymaria as *D. effusa* (B. & C.) Solheim, n. comb. (l.c.). A new specific name is, therefore, necessary for the fungus on Lobelia and *C. lobeliaecola* is chosen.

DIDYMARIA (Corda) *emend.* Solheim

Didymaria Corda, Icon. Fung., 5: 9, 1842; Anleit., p. 32, 1842; Icon. Fung., 6: 8, 1854.—Saccardo, Syll. Fung., 4: 184, 1886.—Massee, British Fungus-Flora, 3: 340, 1893.—Schroeter in Cohn, Krypt. Flora v. Schlesien, 3: 2: 484. 1897—Lindau, in Engler and Prantl, Nat. Pflanzenfam., 1: 1: 445, 1900 and in Rabenhorst's Kryptogamen-Flora, 8: 377, 1907.

ORIGINAL DESCRIPTION

"Flocci entophyllini, repentis, continui, sporis acrogenis, heterogenis, didymis, dien inspersis."

EMENDED DESCRIPTION

Conidiophores tufted, emerging through the stomata or rupturing the epidermis, simple or branched, more or less geniculate, straight or flexuous, continuous or septate, arising from a loose to compact or tuberculate stroma, hyaline to dark brown. Conidia acrogenous, at times appearing lateral due to further development of the conidiophores, clavate, at first continuous, later becoming one or more septate, hyaline to dark brown.

The type species is *Didymaria didyma* (Unger) Schroeter.

Didymaria didyma (Unger) Schroeter, in Cohn, Krypt. Flora v. Schlesien 3: 2: 484, (1897) 1908.—Lindau, in Rabenhorst's Kryptogamen-Flora, 8: 378, 1907. 2 figs.

Syn. *Ramularia didyma* Unger, Exanth., p. 169, 1833. Pl. II, fig. 10.—Ellis and Everhart, Jour. Myc., 1: 81, 1885.

Didymaria ungeri Corda, Anleit., p. lviii. Pl. B. 9, fig. 1, 1842.—Saccardo, Fungi Ital., Pl. 969, 1881; Syll. Fung., 4: 184, 1886.—Massee, British Fungus-Flora, 3: 340, 1893. fig. 17, p. 274.

Type locality: ?

Spots subcircular to angular, vein-limited, 2–10 mm., at first dark blackish-brown, becoming lighter with one or more concentrically zoned areas variously placed which are greenish, greenish-brown or light brown, the zone bands are raised and somewhat darker than the intervening spaces; border mostly indefinite, rarely definite and then slightly raised and blackish-brown. (On *Anemone virginiana* the spots are brown above and light yellowish below, there is no concentric zonation, and the border is indefinite.) Mycelium internal, rarely external; external mycelium emerging through the stomata, very sparse, hyaline to subhyaline, 1.5–2μ; internal mycelium subhyaline to dilute greenish-yellow, 1.2–2.5μ. Conidiophores hypophyllous, rupturing the epidermis (emerging through the stomata on *Anemone virginiana*), moderately to densely tufted, with a slightly bulbose base, simple, or rarely branched, straight to somewhat flexuous, geniculate, non-stromatic to very loosely stromatic, hyaline to dilute yellowish, 30–125×3–4.5μ, 1–2 septate, conidial scars distinct, scattered. Conidia clavate, hyaline to dilute yellowish, 15–40×3–7.5×4.5–11μ, at first continuous, becoming 1-septate. [Fig. 16.]

On leaves of **Ranunculus* sp., **R. repens* L., **R. septentrionalis* Poir., *R. "acer," R. lanuginosus* L., *R. lingua* L., *R. nemorosus* DC., *R. pennsylvanicus* L., *R. polyanthemus* L., and **Anemone virginiana* L.

The form on *Anemone virginiana* gave spore measurements of 15–35×3–6×4.5–9μ, whereas the forms on *Ranunculus* sps. measured 20–40×4.5–7.5×7–11μ. The conidial scars on the former were slightly denticulate. This was not noted in the *Ranunculus* specimens. These slight differences may or may not be significant. The host reaction differences noted in the description do not appear to have much value as differentiation characters. The stomata of the host species examined are different enough to readily account for the emergence of the conidiophores through them in one case and the rupturing of the epidermis in the other.

Specimens examined: As *Didymaria didyma* (Ung.) Schroet., Sydow, Myc. Ger., No. 1769 (Brandenburg, Germany).—Kryptogamae Exs., No. 1486 (Wurzbachtal, Austria).—Migula, Crypt. Ger., Aust., et Helv. Exs., No. 280 (Eisenach, Thüringia, Germany). As *D. ungeri* Corda, Roumeguère, Fungi Gall. Exs., No. 3487 (Fontainebleau, France).—Ellis and Everhart, Fungi Columb., No. 158 (London, Canada). As *Ramularia didyma* Ung., Thümen, Myc. Univ., No. 2076 (Carniolia; Laibach).—Ellis and Everhart, N. Amer. Fungi, Sec. Ser., No. 1529 (Decorah, Iowa).

Didymaria effusa (Berkeley and Curtis) Solheim, n. comb.

Syn. *Cladosporium effusum* Berkeley and Curtis, Grev. 3: 106, 1875.
Cercospora polygonorum Cooke, Hedw., 17: 39, March, 1878. —Ellis and Everhart, Jour. Myc., 1: 52, 1885.

Cercospora hydropiperis (Thümen) Spegazzini, Anal. de la Soc. Cien. Argentina, Buenos Aires, 9: 191, 1880.—Saccardo, Syll. Fung., 4: 455, 1886.—Carver, Proc. Ia. Acad., 8: 164, 1900.—Kellerman, Jour. Myc. 8: 58, 1902; Ohio Fungi, No. 65.—Spegazzini, Bol. Acad. Nac. Cordoba, 23: 529, 1919.

Helminthosporium hydropiperis Thümen, Myc. Univ., No. 1087, 1878.

Type locality: Society Hill, S. Carolina, Ravenel, Herb. Royal Botanic Garden, Kew, No. 3775.

Spots more or less indefinite, the upper surface of the leaf above the spots occupied by the patches of conidiophores at first becoming pale yellowish, later dark-brown to reddish-brown, below yellowish to brown, the latter obscured by the abundance of conidiophores which give the lower surface of the leaf an olive-brown to Prout's brown, velvety appearance, the patches at first subcircular, then coalescing and eventually becoming effused over the whole lower surface of the leaf; border indefinite. Mycelium internal, irregular, very abundant, subhyaline to olive-brown, 1.5–9μ, stromatic mycelium subhyaline to olive-brown, 3-6.5μ. Conidiophores amphigenous but mostly hypophyllous, loosely so moderately tufted, densely aggregated, straight, somewhat undulate, simple or rarely monopodially branched, arising from a loose to compact or even tuberculate stroma, Prout's brown to Dresden brown, 25–140×3.5–5μ, somewhat enlarged towards tips, up to 7.5μ, continuous or 1–10 septate, conidial scars more or less indistinct, scattered, laterally displaced, occasionally shouldered. Conidia clavate, straight or curved, yellowish, dilute yellowish-brown to dilute Dresden brown, 20–85×3–6×4.5–9μ, at first continuous, becoming 1–6–10 somewhat irregularly septate. [Fig. 15.]

On leaves of **Polygonum acre* HBK., **P. hydropiper* L., **P. hydropiperoides* Michx., *P. pennsylvanicum* L., and *P.* sp.

Germination of several conidia was observed. This occurred most frequently from the basal and apical cells, although from the others as well. From the apical cell the germ tube emerged directly from the tip and grew directly away from it. In the basal cell the germ tube arose either at the top of the cell and then grew at right angles to it, or it arose just next to the scar of attachment and then curved away from the conidium and proceeded parallel to it but in the opposite direction.

On several of the specimens pycnidial or perithecial-like bodies were present in the older spots. That these belong to the fungus in question is evident. They arose from the same mycelium as the conidiophores, and not infrequently tufts of conidiophores originated in them, either from the globose portion or from the wall surrounding the ostiole. These bodies are globose, ostiolate, dark olive-brown, and measure 25–70μ in diameter.

The type specimen, *Cladosporium effusum* B. and C., Kew, No. 3775, has been examined. In this specimen most of the mature conidia have fallen off. A few, however, were present, showing this specimen to be the same in all respects as the type specimens and others recorded under the synonymy listed above.

Specimens examined: As *Cladosporium effusum* B. and C., Herb. Royal Botanic Garden, Kew., No. 3775 (type), courtesy of the Royal Botanic Garden, Kew) (Society Hill, S. Car.). As *Helminthosporium hydropiperis* Thüm., Thümen, Myc. Univ., No. 1087 (type) (Aiken, S. Car.). As *Cercospora hydropiperis* (Thüm.) Speg., Roumeguère, Fungi Gall. Exs., No. 3994 (Jersey City, N. J.).—Ellis and Everhart, Fungi Columb., No. 391 (Port Byron, Ill.).—Bartholomew, Fungi Columb., Nos. 2311 (London, Canada); 2707 (Loup City, Neb.); and 3208 (Luray, Va.).—Kellerman, Ohio Fungi, No. 65 (Columbus, Ohio). As *C. polygonorum* Cooke, Ravenel, Fungi Amer. Exs., No. 66 (type) (Aiken, S. Car.).—Rabenhorst-Winter, Fungi Europaei, Ser. II, Nos. 3289a (Perryville, Mo.) and 3289b (Cobden, Ill.).—Seymour and Earle, Ec. Fungi, Nos. 370a (Millstone, N. J.) and 370b (Meriden, Ct.).—Ellis, N. Amer. Fungi, No. 549 (Delaware Co., Pa.).

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Petroselinum hortense Hoffin.
Cercospora petroselini Sacc.
Phaseolus sp.
Cercospora cruenta Sacc.
Phaseolus lunatus L.
Cercospora canescens Ell. & Mart.
Philadelphus coronarius L.
Cercospora angulata Wint.
Physalis virginiana Mill.
Cercospora physalidis Ell.
Piper sp.
Cercospora portoricensis Earle
Piper aduncum L.
Cercospora portoricensis Earle
Piper hispidum Sw.
Cercospora portoricensis Earle
Piper peltatum L.
Cercospora portoricensis Earle

Piper umbellatum L.
Cercospora portoricensis Earle
Platanus occidentalis L.
Cercospora platanicola Ell. & Ev.
Polygonum sp.
Didymaria effusa (B. & C.) Solheim
Polygonum acre HBK.
Didymaria effusa (B. & C.) Solheim
Polygonum hydropiper L.
Didymaria effusa (B. & C.) Solheim
Polygonum hydropiperoides Michx.
Didymaria effusa (B. & C.) Solheim
Polygonum pennsylvanicum L.
Didymaria effusa (B. & C.) Solheim
Prunus virginiana L.
Cercospora cerasella Sacc.
Ranunculus sp.
Didymaria didyma (Ung.) Schroet.
Ranunculus "acer"
Didymaria didyma (Ung.) Schroet.
Ranunculus lanuginosus L.
Didymaria didyma (Ung.) Schroet.
Ranunculus lingua L.
Didymaria didyma (Ung.) Schroet.
Ranunculus nemorosus DC.
Didymaria didyma (Ung.) Schroet.
Ranunculus pennsylvanicus L.
Didymaria didyma (Ung.) Schroet.
Ranunculus polyanthemus L.
Didymaria didyma (Ung.) Schroet.
Ranunculus repens L.
Didymaria didyma (Ung.) Schroet.
Ranunculus septentrionalis Poir
Didymaria didyma (Ung.) Schroet.
Raphanus sativus L.
Cercospora atrogrisea Ell. & Ev.
Reseda odorata L.
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Rhus sp.
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Rhus canadensis Marsh.
Cercospora rhoina Cooke & Ell.
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Rhus glabra L.
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Rhus pumila Michx.
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Rhus typhina L.
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Ribes sanguineum Pursh
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Rosa blanda Ait.
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Cercospora rubi Sacc.
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Sagittaria latifolia Willd.
Cercospora sagittariae Ell. & Kell.
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Cercospora depazeoides (Desm.) Sacc.
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Smilax hispida Muhl.
Cercospora petersii (B. & C.) Atk.
Smilax laurifolia L.
Cercospora petersii (B. & C.) Atk.
Smilax mauritanica L.
Cercospora smilacis Thüm.
Smilax rotundifolia L.
Cercospora petersii (B. & C.) Atk.
Smilax tamnoides Gray (5th ed. of Man.)
Cercospora petersii (B. & C.) Atk.
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PLATE I

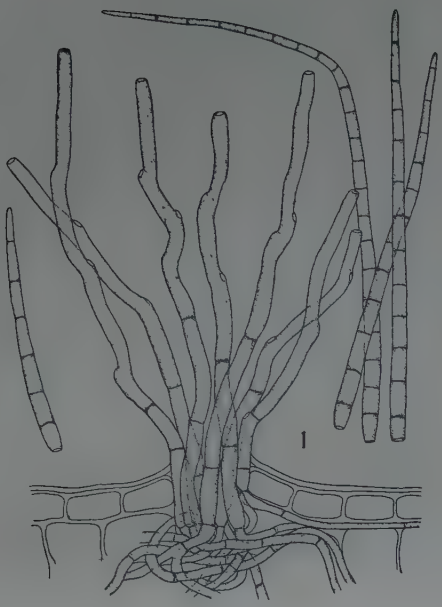
EXPLANATION OF PLATE I

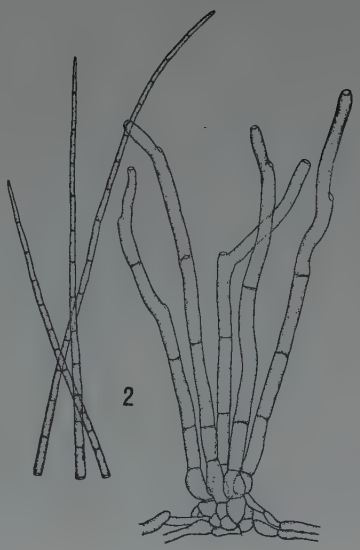
FIG. 1. *Cercospora apii* Fresen., conidiophores simple, loosely stromatic; conidia acicular to acicular-obclavate.

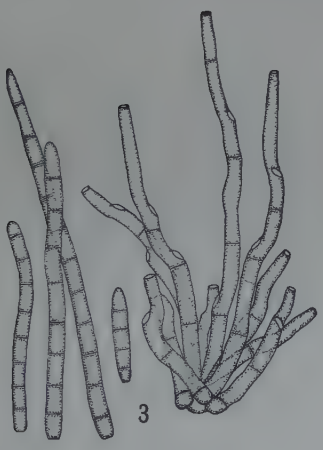
FIG. 2. *Cercospora acalyphae* Peck, conidiophores simple, loosely stromatic; conidia acicular.

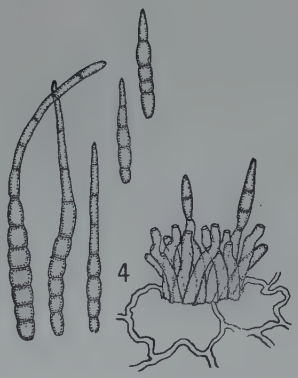
FIG. 3. *Cercospora althaeina* Sacc., conidiophores simple; conidia cylindrical.

FIG. 4. *Cercospora gymnocladii* Ell. & Kell., conidiophores simple; conidia abruptly obclavate.









SOLHEIM CERCOSPORA PLATE I

PLATE II

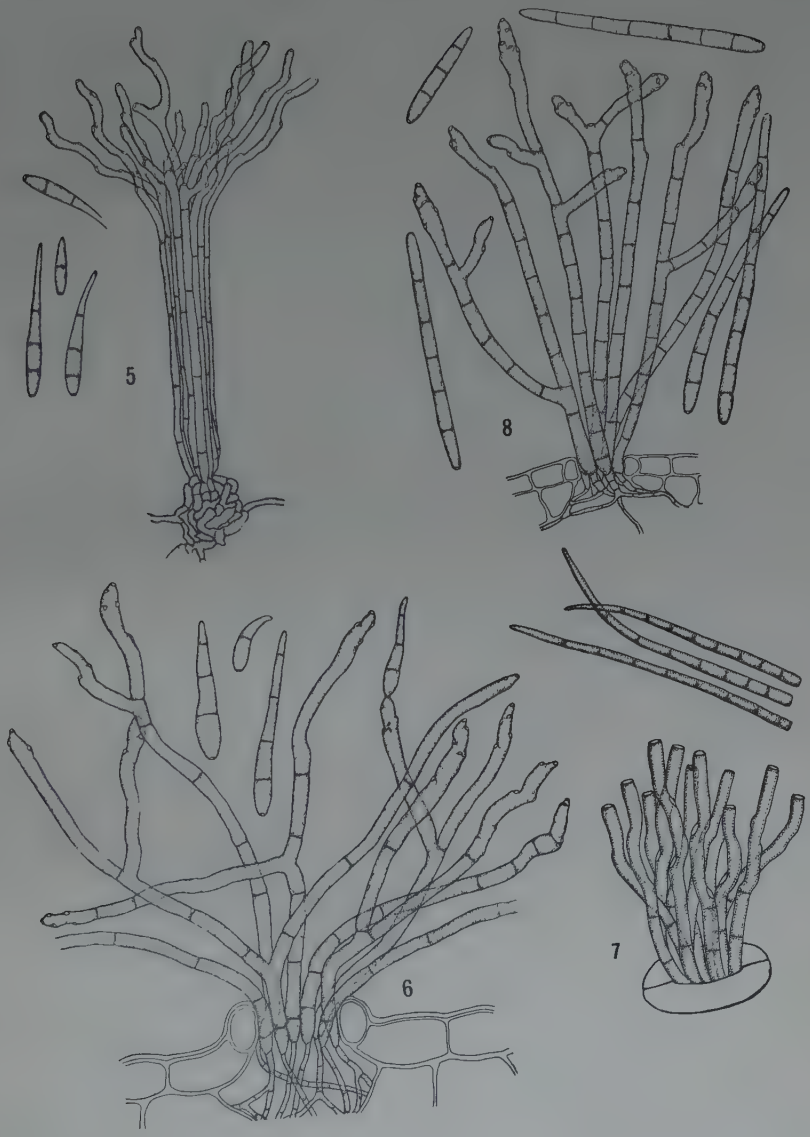
EXPLANATION OF PLATE II

FIG. 5. *Cercospora cercidicola* Ell., conidiophores coremioid, with opposite branching, loosely stromatic; conidia abruptly obclavate.

FIG. 6. *Cercospora ferruginea* Fckl., conidiophores with alternatebr anching, non-stromatic; conidia abruptly obclavate.

FIG. 7. *Cercospora resedae* Fckl., conidiophores simple; conidia acicular.

FIG. 8. *Cercospora illinoensis* Barth., conidiophores with opposite and alternate branching, substromatic; conidia cylindrical.



SOLHEIM CERCOSPORA PLATE II

PLATE III

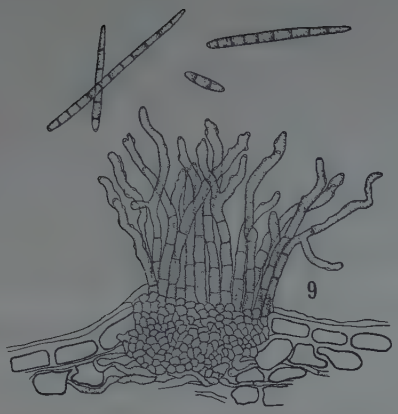
EXPLANATION OF PLATE III

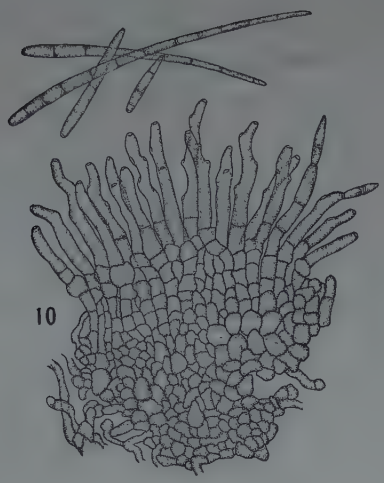
FIG. 9. *Cercospora smilacis* Thüm., conidiophores with alternate branching, arising from a tuberculate stroma; conidia cylindrical.

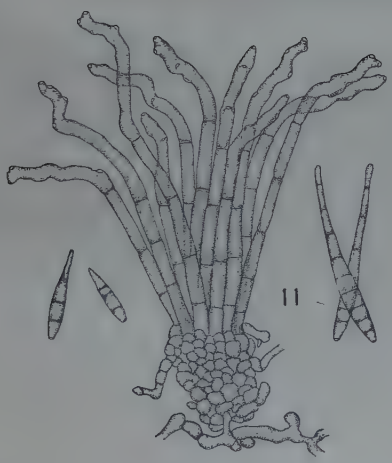
FIG. 10. *Cercospora smilacina* Sacc., conidiophores simple, arising from a tuberculate stroma; conidia acicular-obclavate.

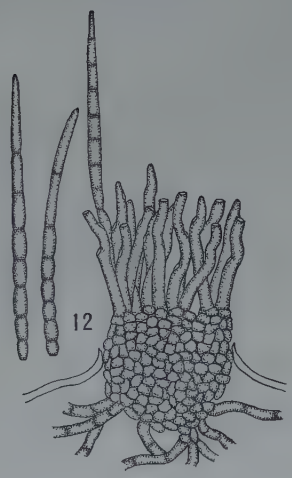
FIG. 11. *Cercospora petersii* (B. & C.) Atk., conidiophores simple, more or less coremioid, arising from a tuberculate stroma; conidia abruptly obclavate.

FIG. 12. *Cercospora tuberosa* Ell. & Kell., conidiophores simple, arising from a tuberculate stroma; conidia cylindrical.









SOLHEIM CERCOSPORA PLATE III

PLATE IV

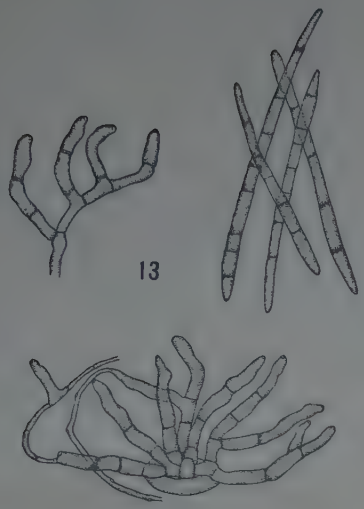
EXPLANATION OF PLATE IV

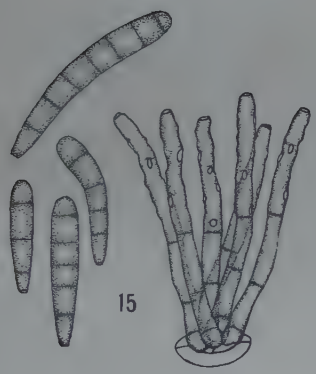
FIG. 13. *Cercospora portoricensis* Earle, external mycelium arising from the conidiophores; conidiophores with alternate branching, arising from the internal mycelium or effused on the external mycelium; conidia cylindrical.

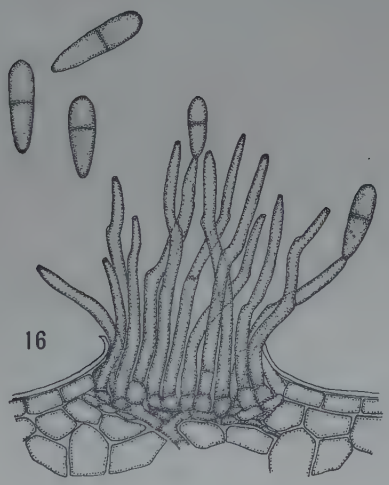
FIG. 14. *Cercospora pastinacae* (Sacc.) Peck, conidiophores simple, substromatic; conidia fusiform.

FIG. 15. *Didymaria effusa* (B. & C.) Solheim, conidiophores simple; conidia clavate.

FIG. 16. *Didymaria didyma* (Ung.) Schroet., conidiophores simple, substromatic; conidia clavate.







SOLHEIM CERCOSPORA PLATE IV